SITING THE INDUSTRIAL CEMETERY

New Burial Grounds and Crematory for Braintree, MA

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ABSTRACT

The contemporary urban condition has placed a great deal of stress upon American cemeteries. Many cemeteries, once sited at the edge of cities and towns, are now surrounded by urban sprawl and development of surrounding land. Boundaries become blurred and undefined, and incompatible programs are placed at the edges of the cemetery. Development and exploitation of land has resulted in the fracturing of a sacred environment in urban cemeteries, and some cemeteries have been displaced in the pursuit of developing land. The rituals and attitudes surrounding death and burial are also changing. Cremation is beginning to precede over burial for economic and practical reasons, and the rituals of death are becoming less personal.

This thesis will address these issues through the critique and design of a new extension for the Blue Hill Cemetery, in Braintree. The process of design will consist of two investigations: the initial design of a crematory complex and burial ground, and an exploration of natural and artificial light in the complex's structures. The latter investigation is conducted through computer modeling, and it will also explore the computer's potential as a design tool.

The first design investigation will recognize the pressures of the urban condition surrounding the old cemetery. An informed response is required—one that recognizes past and present uses of the site as well as the need to redefine the cemetery as a sacred space. Excavation of an existing landform is necessary to expand the cemetery, and the exploited land will need to be reclaimed as a sacred place.

The movement towards the industrialization of the rituals surrounding death and burial have a counterpoint in the human aspects of the industry of excavating the land. The existence of a cemetery extension on the site of a defunct quarry and concrete batch plant allows the two sequences to begin a dialogue. The industrial cemetery reveals the human aspects of the concrete and quarrying industries. At the same time, the cemetery site draws upon its past mechanical existence to impart its industrial nature to those who experience it.

The industrial processes required to excavate and process the land inform the organization and design of the cemetery extension. The crematory's presence will permit the funeral ritual to be affected by the industrial sequences of excavation and aggregate production. Additionally, the undefined boundary conditions around the cemetery will be engaged, integrating original cemetery, the new extension, and the juxtaposed urban fabric of the site.

The second design investigation involves the inclusion of a fourth process into the project—the harvesting of light. Natural and artificial light become commodities to be processed by the structures of the crematory. The computer's ability to aid or inhibit the process of design and representation of light harvesting will be explored and tested. This new process will reinforce the initial investigation of the funeral, concrete batching and quarrying rituals/processes. At the same time, the separate buildings of the complex will be bound into a functioning unit through the harvesting ritual.

Thesis Supervisor: Ann Pendleton-Jullian, Assistant Professor of Architecture

"What is it in your dirty, private, selfish little mind that you really want to do?"

--Francesco Passanti, to the author

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INTRODUCTION

This thesis was undertaken as a two semester investigation.

The first semester concentrated on the thesis project design—the conception and creation of a new burial ground and crematory complex for the Blue Hill Cemetery in Braintree, Massachusetts.

The second investigation was derived from insights gained during the design process. Illuminating the cemetery, and the activity of light in buildings supporting the ceremonies surrounding death, became critically important. A method for investigating the illumination of the cemetery in the industrial landscape—Harvesting Light—was identified, and it would bbegin to define natural and artificial lighting schemes. This investigation was undertaken through extensive computer modeling.

The definition of the light harvesting process is highly suited to the capabilities of the computer. The computer's value as a design aid was explored through the investigation and redesign of an existing project. Combinations of natural and artificial light were easily tested. A new medium for investigation permitted an exploration of issues not deeply addressed in the first semester. Additionally, the computer permitted a subversion of the process which led me to the original design, and it stimulated my thinking about the thesis in a manner different from my first semester explorations with pencil, paper and models.

The final conception and presentation of the thesis is loosely based upon a tapestry, with the Bayeux Tapestry serving as an analog. My thesis is not so much a project with definite finality as it is a story of invention, exploration and rediscovery. The thesis project became a vehicle for two primary investigations: understanding and redefining the nature of the contemporary cemetery and the funeral ritual; and the creation of a process to unify the buildings in the new burial grounds. The final presentation "tapestry" tells the story of these investigations.

DEATH THROUGH AN OBJECTIVE LENS

The nature of this thesis investigation required me to explore issues surrounding death and the cemetery from a objective viewpoint. Without the benefit of objectivity, many of my explorations would not have been logical considerations for a thesis on the contemporary cemetery. In fact, a subjective attitude towards death is diametrically opposed to the very idea of an industrial cemetery and the formal solutions generated within in it. For these reasons, an objective attitude about death and the cemetery was critical.

Objectivity permitted me to conceive of the fundamental investigations in my thesis. Under the objective lens, nothing is inherently "good" or "bad," but simply a potential alternative for investigation within my project. Remove objectivity, and comparison of the industrial nature of the funeral ritual with the human aspects of an industrial process would have been impossible. The creation of a sacred space from a deliberately profane act becomes blasphemous. Subjectivity would demand consideration of the dead body solely in a sacred manner, which is antithetical to my polemic concerning contemporary funeral practice.

The demands of subjectivity would not permit my redefinition of the cemetery and the funeral ritual. A subjective approach to the cemetery would require strong consideration of the historical funeral practices in New England, with little opportunity for radical deviation. Through the objective lens, I am able to free the ritual from its Puritan past and consider it as a funeral ritual of cremation, not burial. Consequently, ideas and influences from Eastern religions with a history of disposing of the dead through cremation, Hinduism and Buddhism, could be incorporated into the project.

Objectivity also allowed me to reconsider the notion of ground as sacred in the industrial landscape. I was able to utilize the sky as a sacred space in the new cemetery—an idea held by

many Mesomerican Indian groups and some Asian cultures, such as Tibet. If the investigation was tied to a subjective interpretation of the New England cemetery the notion of a sacred void/sky would not be a credible one.

Additionally, the subjective nature of death demands an emotional response—death equals grief and pain for those who must deal with it. Objectivity allows that response to be repressed in favor of a careful, thorough investigation of the potential architecture of death. Profane and sacred notions towards an architecture of death can be considered, although the end result should be human, sensitive, and appropriate to the nature of death.

As a final note—the language used to describe the thesis is detached and objective. This reflects the manner in which I investigated and resolved the questions of the industrial cemetery. This thesis, if written subjectively with great passion concerning the subject of death, would be a very different document. I have become comfortable viewing death with objectivity and tapping into its subjective requirements as necessary; I hope others will do the same when considering the merits of this thesis.

SITING THE INDUSTRIAL CEMETERY

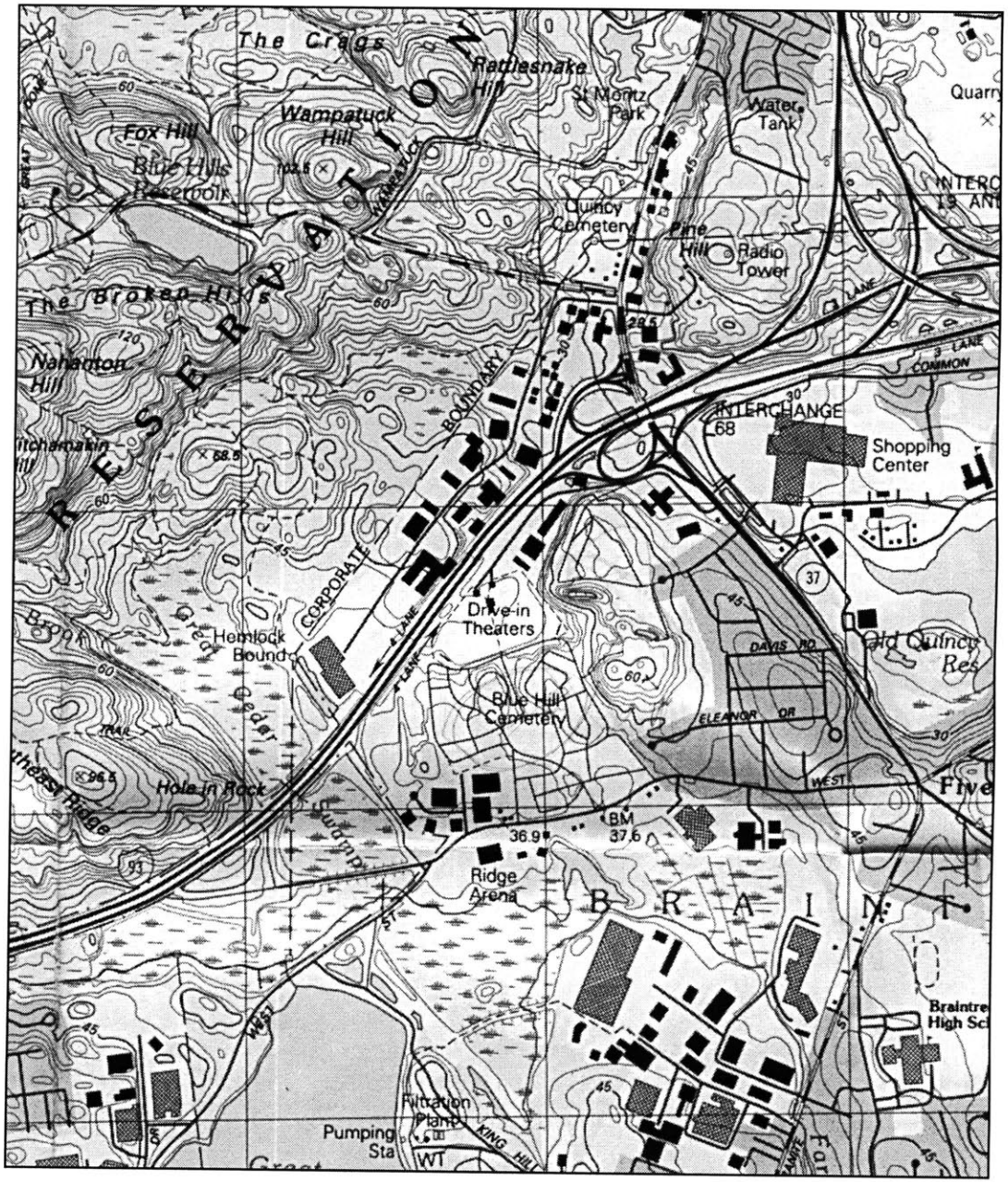


figure 16.1. Partial topographical map of Blue Hill Cemetery and the surrounding area.

BLUE HILL CEMETERY

THE SITE

Blue Hill Cemetery is a incorporated parcel of land located in western Braintree. It was originally founded in 1892, when a group of businessmen purchased fifty acres of farmland for the purpose of creating a cemetery. At the time of its inception, the cemetery was located at the western edge of the city limits, and the Blue Hill Forest Reservation surrounded the cemetery on three sides. Today, the forest has yielded to development, which surrounds the cemetery on all sides. In 1992, plans were formulated for an expansion of the cemetery into undeveloped land east of the original cemetery.

Physically, Blue Hill Cemetery is laid out in the manner of an English-style garden cemetery. Its main entrance is on West Street, at the southern edge of the cemetery. Several rockeries were built there between 1900 and 1933; presumably, the rockeries strengthen the edge of the site, reduce noise from traffic, and emphasize the cemetery entrances. The original layout of Blue Hill Cemetery was a trio of east-west roads (figure 16.1), but subsequent growth has not followed these roads. Instead, the roads have been designed in a meandering manner with gravesites arranged in rows perpendicular to the roadways. The cemetery is not homogenous, for three different methods of interment are employed—in-ground burial, a memorial park area in the northern third of the cemetery, and a columbarium wall near the cemetery's center (fig. 19.1 and 19.2). There is no apparent scheme for the location of

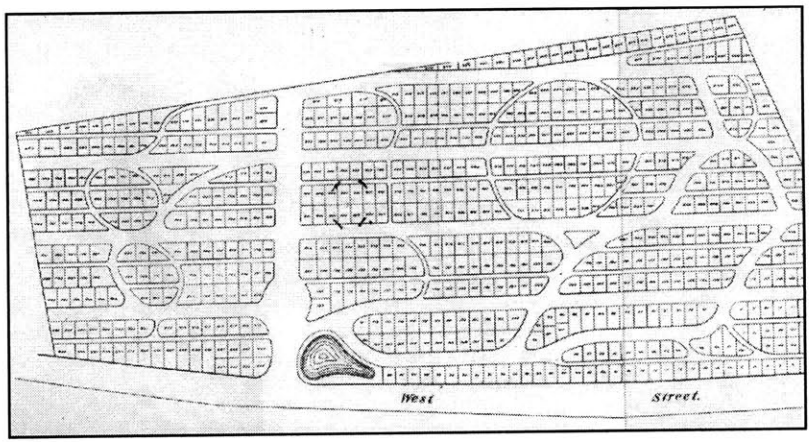


figure 17.1. Blue Hill Cemetery, 1892.

figure 18.1. Blue Hill Cemetery, 1995.

these different burial spaces, and the cemetery areas devoted to burial are very densely packed.

The site for this thesis investigation is a parcel of land north and east of Blue Hill Cemetery. Most of this land is owned by the cemetery, and it is slated for eventual development. The land rises into a forested hillside with sweeping views west to the cemetery and the Blue Hill Reservation (fig. 21.2 and 25.1). The summits of this area are between 190' and 200' above sea level, roughly 80 feet above most of the existing cemetery. This landform slowly drops in elevation towards Five Corners, away from Blue Hill Cemetery. The southern half of this land is currently being blasted and excavated to facilitate the cemetery expansion. A significant part of the existing landform will be removed, greatly altering the landscape, in order to maintain a continuous garden-style cemetery fabric.

The land surrounding the project site and Blue Hill Cemetery contains a strange collection of historical and contemporary programmatic use. Many excavations have taken place since 1935, all with the purpose of developing land near the cemetery. Aerial photography and highway survey maps reveal large-scale interventions to the north during the 1950s, when Interstate 128 was built.

Further excavations in this area occurred in the 1970s for the construction of a corporate park. All of these interventions resulted in the removal of forested or agricultural land. The western edge of the cemetery has suffered extensively from the effects of deforestation and subsequent development; an industrial park has claimed the land southwest of the cemetery, and the northwestern corner is a muddy, overgrown field containing a private dumping ground.

The land directly north of Blue Hill Cemetery has its own peculiar history of use. Until the late 1980s, a two screen drive-in movie theater occupied the area between Interstate 128 and the cemetery. Today, the theater is defunct although the screens remain intact. The western half of this area is now a parking storage lot for the Logan Park 'n Fly shuttle service, and the eastern half is a driving range and mini-golf course. The driving range is oriented towards the cemetery, and nets have been erected to prevent errant golf balls from entering the cemetery.

A shallow ditch and creek provide the only physical separation between the cemetery and the old drive-in theater (fig. 21.1). The low profile of the shuttle parking lot and driving range does not prevent visual access between Interstate 128 and the cemetery. Noise from the highway is a constant presence on this edge of the site.

East of this region are a series of disparate commercial buildings. An indoor theater cineplex sits atop the northern end of the forested hills, and a corporate building is located east of this theater. Four story commercial properties line an access road which connects the shuttle lot and driving range to Granite Street. At the entrance to this access road is a large hotel complex and a gas station, neither of which has any relationship to the cemetery.

Farther east of the cemetery and the thesis site is an unremarkable residential subdivision. It was constructed between 1953 and 1972. The woods that cover this hillside once extended over the subdivision. The majority of these house are single-family dwellings.

The excavation to expand Blue Hill Cemetery is adjacent to the eastern cemetery ring road. The construction / excavation site

Typical burial conditions in Blue Hill Cemetery.

figure 19.1. (top). Dense organization of grave markers, northeast cemetery.
figure 19.2. (bottom). Memorial park, looking south, northwest cemetery.

figure 20.1. Southeastern corner of Blue Hill Cemetery.
The unbounded cemetery abuts the yards of houses in the residential district with little physical or visual separation.

entrance is actually inside the cemetery property line, forcing trucks and equipment to move through the cemetery in order to reach the excavation. A scale house has been constructed at the southeast corner of the cemetery to regulate construction traffic.

The combination of programmatic uses bordering and intruding upon the cemetery has eroded the cemetery's perimeter conditions and placed unnecessary stress upon the cemetery itself. Lack of cemetery planning has also contributed to these problems. Headstones in the undefined southeastern corner of the are uncomfortably close to the backyards of subdivision houses, creating an extremely awkward condition (fig. 20.1). The undeveloped northwestern cemetery edge disappears into a muddy field and scrub trees, and the tiny creek north of the cemetery ring road provides no visual edge for the cemetery. The odd combination of buildings north of the cemetery provides no barrier to the highway, and no visual edge for the cemetery. The sacred nature of the cemetery has been damaged by these developments, and it is in need of repair.

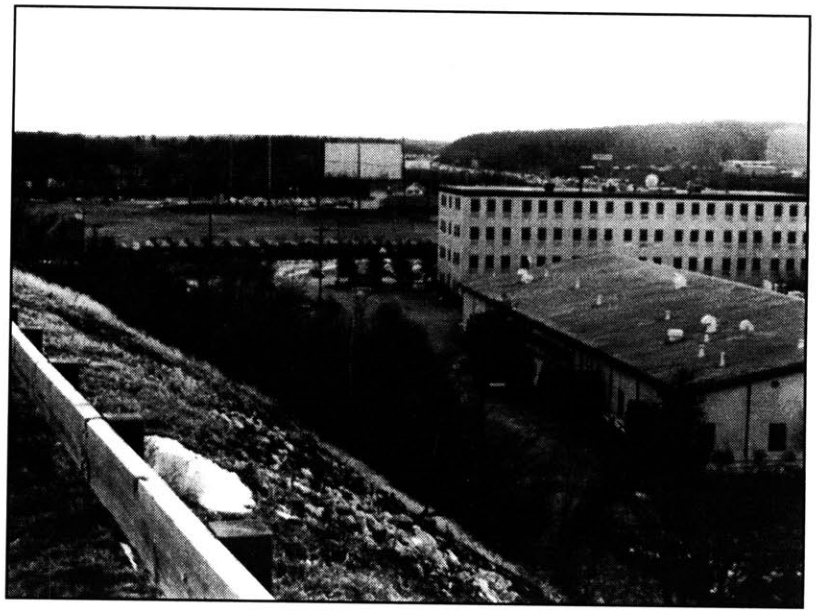


figure 21.1 ***Perimeter road, northern cemetery edge.***
The scrub trees conceal a shallow creekbed; they provide a minimal barrier to the highway and parking lot / driving range.

figure 21.2. ***View from hillside across driving range and parking lot, looking west.*** *The unusual combination of building types and land usage is evident in this photograph. The dense trees in Blue Hill Cemetery are directly behind the drive-in screen; Interstate 128 is to the right of the screen.*

THE NATURE OF THE INDUSTRIAL CEMETERY

The industrial cemetery is a design solution to a condition that threatens many American cemeteries. Specifically, it addresses the conditions surrounding the Blue Hill Cemetery in western Braintree. Nineteenth century cemeteries were often sited outside of towns and cities, and future land development around them was not a planning consideration. However, urban growth and land speculation have encroached upon the land surrounding these burial grounds. Developed land may be zoned and utilized in manners highly problematic to the maintenance of a "sacred precinct" these cemeteries once enjoyed; this problem is compounded in cemeteries that do not possess well-defined edges and boundary conditions. When (and if) expansion is required, the question of the new burial ground's form is critical.

An extension of a cemetery that has been surrounded by development must consider several things: the nature of acquired land, the history of that land's use, and the nature of the attitudes surrounding death at the time of the extension's construction. Blue Hill Cemetery sits within a highly industrial landscape.

Land surrounding the cemetery has been heavily quarried in the past to support the construction of an interstate highway and commercial development. The current excavation to extend the cemetery will insinuate an industrial character into the land. The memory of this act should be considered in the development of the new extension.

At the same time, this new extension should reflect the changing attitudes towards funerals and death present in society. The funeral ritual, which is historically steeped in the relationship between the living mourners and the deceased, is becoming increasingly disrupted. The body is treated as an object to be processed, while the ritual itself has broken down. Additionally, cremation is an increasingly popular method for interment. An industrial aspect is present in the ceremony of death itself, and it must be dealt with in the new extension.

Reconciliation of the industrial nature of the American funeral ritual and the site of the new cemetery extension is an opportunity to achieve several things. The presence of a crematory will provide alternative, progressive option for interment for the citizens of Braintree and neighboring communities. An acceptance of the industrial nature of funerals can restore the historical bond between living and dead in the funeral ritual, and it can prevent further de-humanization of the ceremony surrounding death. The profane act of excavation can be revealed for what it is, and a sacred precinct can be created inside of this commoditized land. Lastly, the memory of the site's industrial legacy can be celebrated in the forms of the crematory complex and its burial ground.

The industrial cemetery becomes a mental construct which roots the design of the crematory and burial ground to the industrial legacy of its site. It recognizes past uses of the land, and the marks inflicted upon the landscape by man. The processes which have affected the land, such as quarrying, aggregate production, and concrete batching, provide clues to the form and nature of the new burial ground. Finally, the industrial cemetery becomes a vehicle for redefining a marginalized cemetery as a sacred precinct.

*figure 25.1. **Northern end of unexcavated hillside, looking southwest**. The dense fabric of old trees in the cemetery provide an appropriate environment for contemplation of death. However, the compromised northern edge is detrimental to the cemetery environment. The drive-in screens define the boundary of the old drive-in theater. In the center of the photograph, the Blue Hill Cemetery columbarium is visible.*

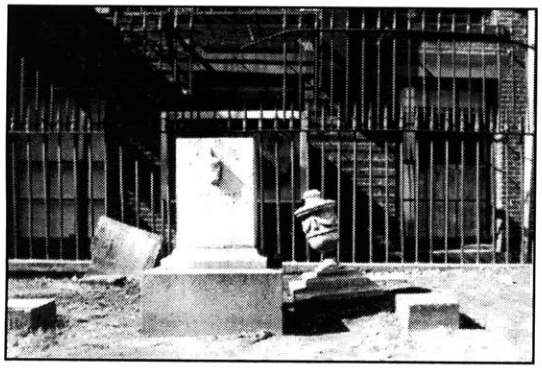
figure 26.1 ***Panoramic view, looking west, of the excavation site for the new cemetery extension.*** *In the background is the Blue Hill Reservation. November 1994.*

THE CEMETERY IN THE INDUSTRIAL LANDSCAPE

The importance of the cemetery as sacred ground, and the value of this land in the eyes of society, has changed dramatically in the 104 years since Blue Hill Cemetery was founded. The Parisian garden cemetery of Peré-Lachaise, founded in 1804, was one of many early 19th century French cemeteries to be relegated outside of the town walls. This relocation of the cemetery occurred in response to a lack of available land in the French cities, and for reasons of health and public safety. England and the United States copied this gesture of de-urbanizing new cemeteries, and this became standard practice for most garden-style cemeteries. While cemetery grounds located inside city limits were always well-defined and bounded by a wall or enclosure, this practice did not always occur in American cemeteries outside the city.

Consequently, edge conditions in many of these cemeteries become marginalized when the city grows to encompass them. The Granary Burial Grounds in downtown Boston is but one example of this condition; many of the headstones at the cemetery's perimeter have been damaged or displaced by the buildings at its perimeter (figs. 28.1 and 28.2).

The value of land in the city has also risen dramatically during the 20th century. This condition has disrupted many urban cemeteries, as they may be completely removed in favor of more profitable development. One particularly telling example can be seen in New York City. At one time, forty cemeteries could be



figures 28.1 (top) and 28.2 (bottom). Compromised perimeter conditions in the Granary Burial Grounds.

found south of 14th Street; today, few remain as a result of development in the city core.[1] While Blue Hill Cemetery is in no danger of being eradicated, the land at its borders has been treated as a commodity. The multiple histories of the drive-in theater /parking lot /driving range north of the cemetery are one example of this type of land use. Even the peaks of the forested hillside, which have sweeping views west to the old cemetery and Blue Hill Reservation, are misused; the cineplex occupying the site is a windowless "black box", and its parking lot occupies the "prime view" space of the hill.

The site I have chosen for the new cemetery extension is within the parcel of cemetery-owned land. The cemetery owners' method of preparing this land for consecration is fundamentally anathema to the notion of sacred ground.

The developments at the cemetery's edges have merely eroded the sacred nature of the cemetery, but the excavation for Blue Hill Cemetery's expansion is a profane act upon the land. Excavation blasts and scars the land, but the future proposal denies the existence of these acts. The garden-style burials of the old cemetery will be continued in the extension, which conceals the activity required to create this new burial ground.

A more honest approach would be to reveal the land for what it is — a commodity — and to design a burial ground that reveals man's marks upon the land. If the excavation of land is taken as a given for the cemetery extension, and the processing of aggregate is necessary, a small concrete batching facility can be erected near the quarry—permitting full processing of the land, and providing concrete to future development in the Braintree /Five Corners area. The memory of these processes becomes an impor-

tant consideration for the design of the new burial ground.

The industrial, quarried, nature of the landform is also important when the contemporary funeral ritual is considered. The ceremony surrounding death in America has become increasingly impersonal. With the rise of cremation as an alternative to burial, and a change in the perception of the body before interment from sacred object to funeral product, an industrial character has insinuated itself into the funeral ritual. Without careful consideration and mediation of this change, the ritual itself may be reduced to a funeral *process* in the future.

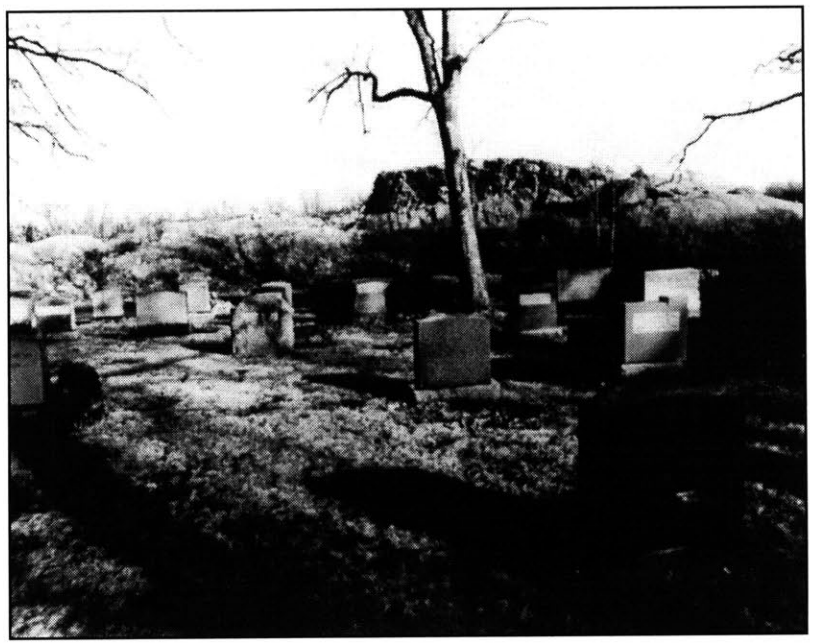


figure 29.1. Eastern edge of Blue Hill Cemetery. *The blasted exacavation exerts a strong presence in the landscape as well as within this area of the cemetery.*

CREMATION, BURIAL AND THE FUNERAL RITUAL

The re-evaluation of the cemetery fabric in Blue Hill Cemetery naturally lends itself to the question of burial practices. When Blue Hill Cemetery was founded in 1892, cremation was not as common as it is today. Cremation has become more widely accepted in the United States within the last 25 years; in 1970, only 4.6% of all American dead were cremated, while 18% were cremated in 1988.[2] Although usage of cremation varies widely in the United States according to region and local culture, it is a safe assumption that cremation will become more prevalent in New England in the future.

The nationwide rise in cremations coincides with an abandonment of traditional funeral practice in New England. Roman Catholic families, especially those of Irish-American and Italian-American descent, observed traditional burial customs until as recently as 30 years ago (families of other faiths were not so vigilant in the observation of these rituals). When a death occurred, the body was kept in a house for three days, and a constant vigil was kept by family members; the mortician or funeral director would perform his services in the house of the deceased; visitation occurred in the house, not in a funeral home; and the family would travel with the body to the church for the funeral as well as to the cemetery to intern the body in the ground.[3]

Today, the average funeral ritual has changed significantly. After a death occurs, a call is placed to a coroner or EMTs, who

arrive, unceremoniously remove the body, and place it in a mortuary refrigeration unit. All preparation of the body occurs at the morgue or at a funeral home. The next time the family sees the body is often at a wake in a funeral home—this reunion lasts but a few hours. The body is then returned to refrigeration storage, and later removed for the funeral ceremony. The living and the body are again separated after the funeral, and the last fleeting opportunity for contact occurs at the time of interment. If cremation is chosen as the means of disposal, the body is taken directly to the retort after the funeral, ending the ritual in an awkward manner.

The inherent disjunction of the contemporary funeral ritual has severed an important connection between the living and the dead. When the living are not given an opportunity to contemplate death and understand its finality through contact with the deceased, the ritual is dehumanized. The body is treated as a commodity in the funeral industry : it is refrigerated, stored, placed on display, and finally buried or incinerated. The care and attention given to the body in a traditonal, "home" funeral, has been lost in this new practice. The connection between body and the living mourners is broken at the time of death, and not at the time of interment. The sanctity of the ritual is reduced to a mere process that the living must endure in order to dispose of the dead.

While many of these problems are created by a increasingly fast-paced, fragmented society, the American funeral industry does not create an atmosphere for appropriate contemplation of death and mourning. One funeral historian summed up the experience of funerals in the following manner:

Few funerals now take place in church. Too often one is asked to meet at the crematorium, and what then ensues is dismal; an unaccompanied funeral car glides noiselessly under the porte-cochère, the coffin is transferred to a stainless steel 'hors-d'oeuvre' trolley and wheeled into the chapel, which looks more like a waiting room in a university college than a dignified setting for the disposal of the dead. Ten minutes later, to the accompaniment of slurred, canned music, the curtains jerk their way noisily round the catafalque as the coffin sinks slowly through the floor...to the furnace below."[4]

The examination of the contemporary funeral ritual through an industrial lens permits resolution of several critical issues: the separation of the dead from the living; the creation of appropriate ceremonial chambers in crematories; and the redefinition of the funeral ritual to reflect contemporary social attitudes while maintaining its inherent sanctity. The design of the crematory complex and burial ground should also address these problems in a manner appropriate to the nature of the site.

The nature of the burial ground is also significant, for its presence in the landscape may be defined by the manner in which it houses human remains. There are several strong arguments in favor of cremation over in-ground burial:

figure 34.1. Crowded grave markers in Blue Hill Cemetery.

1. *Cremation usually costs less than interment.*
2. *There is a marked decrease of cemetery space.*
3. *Modern cremation methods are clean, quick and efficient.*
4. *Religious tolerance of cremation is greater today than in the past.*[5]

The second argument is critical for a cemetery such as Blue Hill, which is prevented from further expansion beyond its currently planned extension. Continuation of in-ground burial in the new extension will only delay the inevitable filling of the cemetery. Once a cemetery can no longer support additional interment, it becomes vulnerable to disuse and neglect. In a region where land's value is measured through development potential, neglect could become problematic for the future of the cemetery.

A burial ground that recognizes this limitation and can adapt to potential future redevelopment becomes a necessity. At the same time, the burial ground should not be intentionally marginalized; rather, it can exert its presence in the landscape as a reminder of the eventual destiny of the living.

HARVESTING LIGHT

The intention of this investigation was to create a system of admitting natural light into the crematory complex. This system is about processing the light, harvesting it, in order to create sacred zones of light and shadow. The treatment of light as a commodity, processed by the buildings of the crematory complex, strengthens the buildings' ties to an industrial past. Additionally, it provides formal solutions for the buildings' openings and surfaces.

Conceptually, light is considered to be a "fluid" commodity in the complex; as the various parts of an engine work together to process fuel, so the chapels and crematory become a machine for processing light. Each building has a method of harvesting the light which is related to its function, its location in the landscape relative to the other buildings, and its position in the funeral ritual. As someone passes through the buildings in the crematory complex, access to light and view are precisely manipulated and constricted as one moves farther into the complex.

This process culminates with the retort chapels, where the act of placing the body into the retort and closing its door reveals the primary relationship between body, light, and sky. The columbaria are separated from this internalized ritual, but they are joined to the crematory by their role as a depository for cremains and through the organizational scheme of the new extension.

The organization of the crematory and burial grounds is conducive to a process of harvesting light. The major axis of the

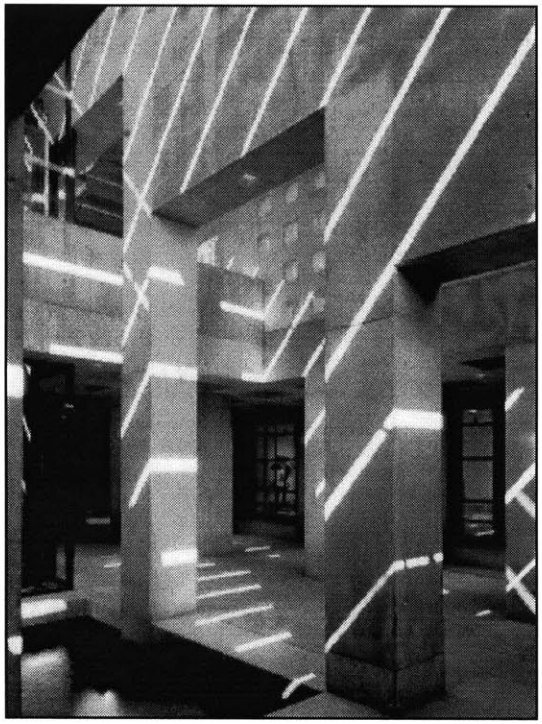


figure 38.1. Subterranean light, Nelson Fine Arts Center. *The main external stairs filter light into the spaces below in a manner similar to Active Harvesting. The openings between the stair slabs permit the entrance of the intense desert light; as time passes, a dynamic pattern of light plays across the concrete piers.*

complex, which includes the columbaria, crematory tower and Chapel of Light, is oriented towards the winter solstice. The location of the Chapel of Shadows along an south-sloping edge of the hillside allows it to be oriented towards the spring and fall equinoxes. Apertures in the metal columbaria shells abstractly define a range of sunrises and sunsets for each month of the year. These relationships to celestial solar events emphasize the importance of sun and light in the complex.

Light harvesting can occur in two ways: active or passive. The difference between active and passive harvesting lies in the materials of the buildings, and in the apertures defined by these materials. Active harvesting occurs when light passes through an opening defined by the building's form. These apertures are often located to admit light only at certain times of the day or year. For example, the roof of the Chapel of Shadows contains several small apertures and a hopper-like slit at its eastern end. Only morning light is admitted through this slit. As in all acts of active harvesting, the intensity of the incoming light is not affected—only its "form." Additionally, artificial lighting schemes are directly influenced by active harvesting of natural light, especially in the Chapels of Light and Shadow.

Passive harvesting occurs when a quality of the material itself affects the light entering a space. The three concentric, perforated steel drums in the Chapel of Light create a performance of passive harvesting. The thousands of holes in the perforated steel allow light into the building without the presence of a formal opening or aperture. The drums' form does not react specifically to the sun's position in the sky, yet the drums admit light into their interiors. Active harvesting in the Chapel of Light occurs only

when the sun is high in the sky, and light passes through the dynamic honeycombed basin that forms the chapel's roof.

The manifestation of active and passive harvesting can be generalized in the following manner: most active harvesting is a vertical process through the roof planes of the complex's buildings, while passive harvesting occurs through the walls of a building. Active harvesting provides a dynamic illumination of an interior space, and focuses the attention of the viewer to the sky—the ultimate destination of the body of the deceased. Passive harvesting brings diffuse light into the illuminated space, and permits one's attention to be focused upon the body.

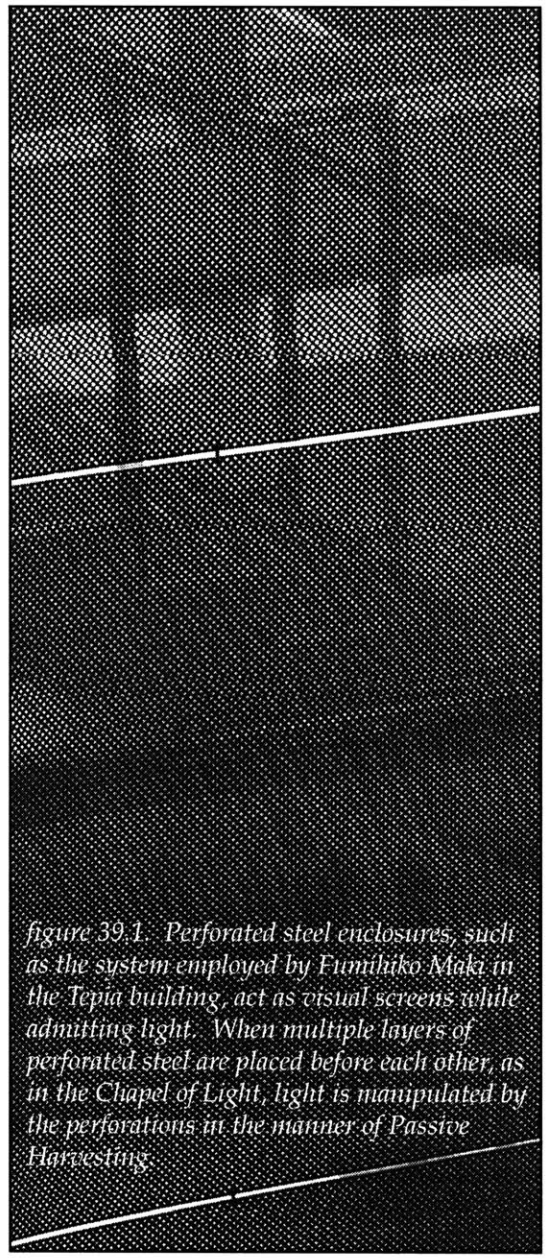


figure 39.1. Perforated steel enclosures, such as the system employed by Fumihiko Maki in the Tepia building, act as visual screens while admitting light. When multiple layers of perforated steel are placed before each other, as in the Chapel of Light, light is manipulated by the perforations in the manner of Passive Harvesting.

figure 40.1. Unmediated boundary condition. *An abandoned drive-in movie screen stands in an overgrown field at the northwest corner of the site. The screen will remain in the new burial ground as an object in a field of aggregate piles. The ascension road leading to the new burial grounds will define the boundaries of this field, and it circles around the screen before engaging the main axis of the cemetery extension.*

BOUNDARY MEDIATION

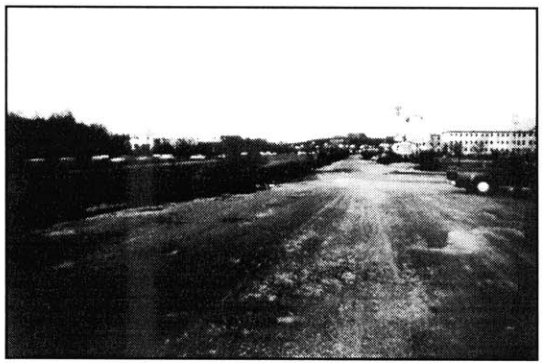
The resolution of all of the problematic boundary conditions surrounding Blue Hill Cemetery was not considered in the thesis investigation. Interventions along Blue Hill Cemetery 's perimeter were limited to the northern and northeast edges, as the redesign of the cemetery extension could easily address these existing conditions.

The solution for the northern boundary attempted to accomplish three things: redefinition of the extant cemetery edge; visual and physical separation of the cemetery from the highway; and integration of the new edge condition with the cemetery extension. These acts will begin to reclaim the cemetery as a sacred environment and space.

The new burial ground had to address two additional issues: definition of its own boundaries, and the creation of a relationship to the subdivision east of the burial ground.

The decision to create a new northern entrance for the crematory complex and burial ground provides a solution to all of the problems along the northern edge of Blue Hill Cemetery (fig. 43.1). The alleés of trees along the access road and the ascension road into the crematory complex define the edges of the old and new cemetery, respectively. At the same time, they create a visual barrier to the highway. The trees will also reduce noise from the highway.

The northern ring road of the old cemetery becomes the



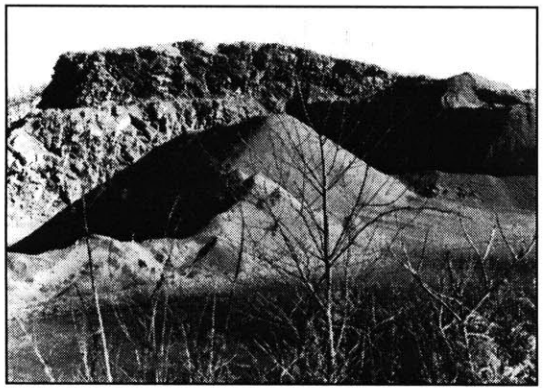


*figure 42.1. (top). **Existing boundary condition between highway and parking lot /driving range, looking east.** This access road will be redefined as the primary entrance for the new burial grounds.*

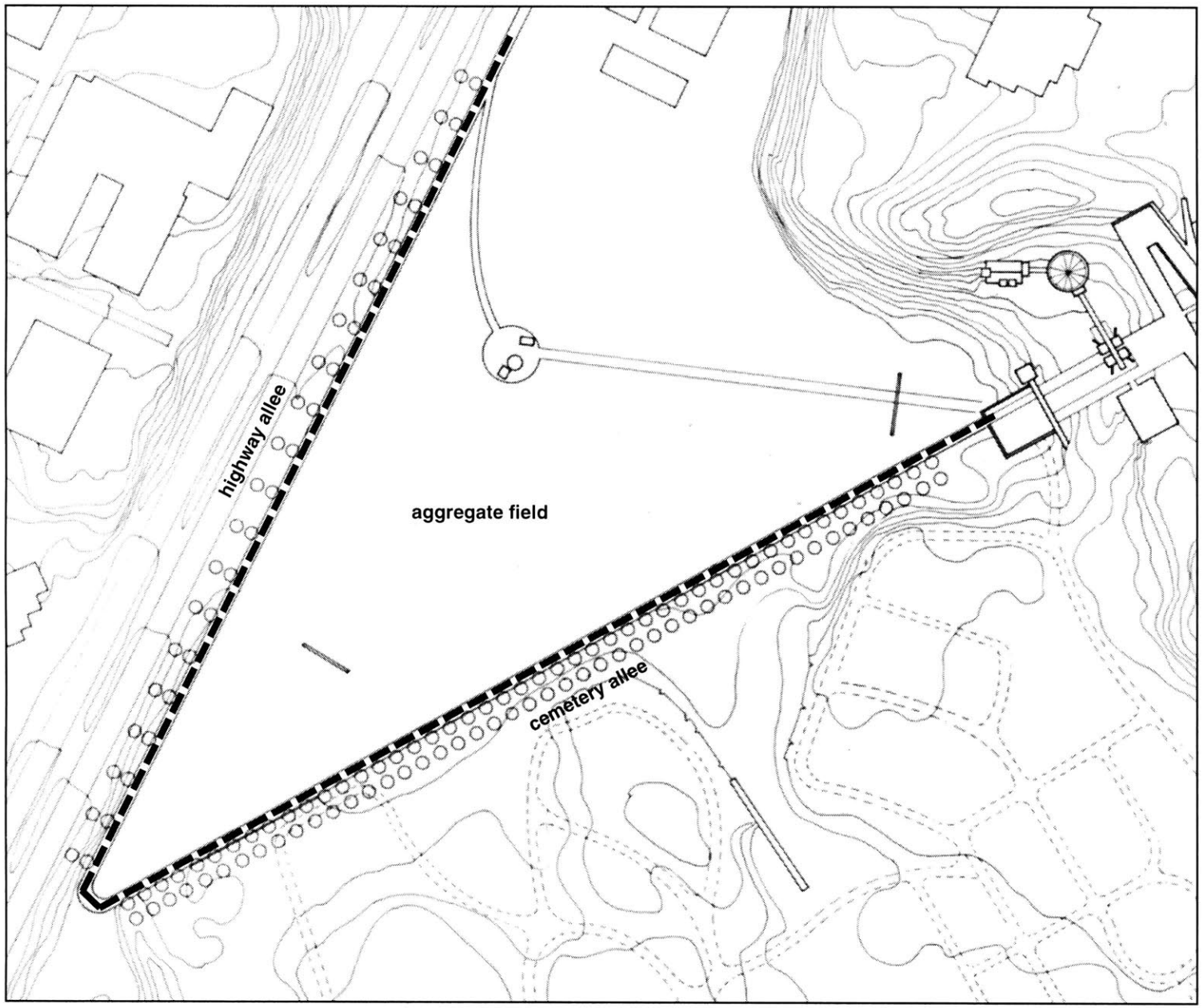
*figure 42.2. (bottom). **Aggregate hills in the excavation area.** The blasted hillside is in the background.*

*figure 43.1 (facing page). **Northern boundary mediation, diagram.** The dotted line defines the two major boundaries for this edge, and denotes the primary route of access to the new extension.*

ascension road into the crematory complex. It also is the major axis of the new extension, which is oriented to the winter solstice sunset. This road is a part of the new cemetery, but the land it sits upon is physically part of the old fabric.

The new cemetery extension utilizes the quarry excavation to define its precinct in the landscape. The buildings of the crematory complex are nestled between the two highest summits in the site, preserving their integrity as the high points in the area. The stepping back and up of the buildings between these hills permits visitors to the complex to obtain views west to the Blue Hill Reservation.

The mixed-use development north of the cemetery is replaced by a large field of low aggregate hills. The drive-in movie screens will remain as surreal objects in an abstract landscape. The aggregate field references the past industrial processing of the land, the land's identity as a product, and sharply contrasts a bounded field of wild grass located at the elevation of the aggregate fields, but inside of the quarry.


highway allee
aggregate field
cemetery allee

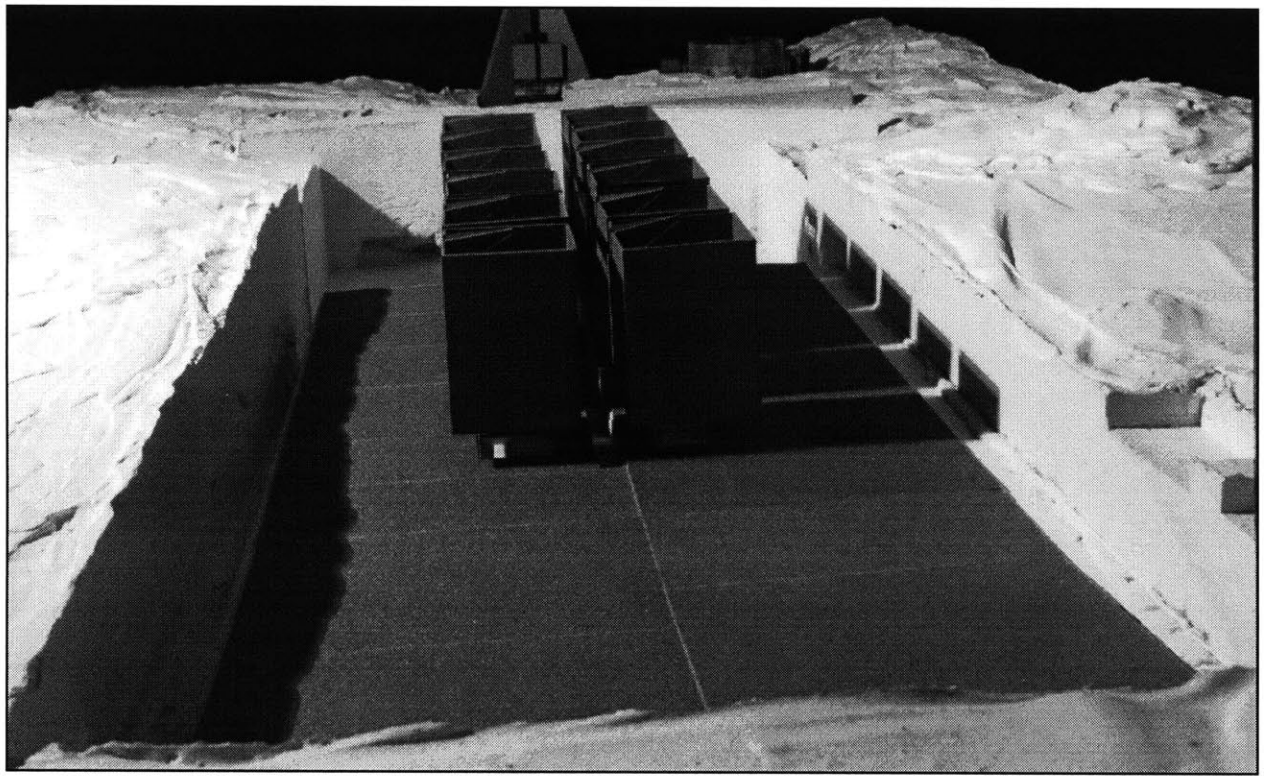


figure 44.1. View of quarry, looking west from residential subdivision. Final model.

SACRALITY IN A PROFANE SPACE

THE QUARRY

The presence of the quarry in the burial grounds is important to the development of the cemetery extension. It defines a volume of the land to be excavated and removed. This volume is an abstract one, for it is impossible to precisely predict how the land will react to blasting excavation. However, the idealized quarry begins to define a zone of space for the new burial ground. The volume of the quarry's void represents the aspect of the quarry that is transformed from profane to sacred. This transformation is accomplished by locating the Burial Ground in the void. In this manner, the sky becomes infused with the sacred quality possessed by the ground in a traditional cemetery.

The quarry is a sectional device that reveals the site's true nature. Rock is removed from a quarry by creating a series of ledges, or benches, where excavation equipment can operate. The presence of a deep quarry allows a bench to be created at the same elevation as the land north of the old cemetery—dramatically revealing the height of the landform to the burial ground's visitors. This bench serves as an artificially depressed ground plane, which contains a field of wild grass. The columbaria are supported above this artificial plane, creating a surreal burial ground that simultaneously references the industrial and agricultural past of the site.

The evidence of man's impact upon the site is also revealed. Instead of creating an artificial cemetery fabric to mask the scars of excavation, these scars are retained as an integral part

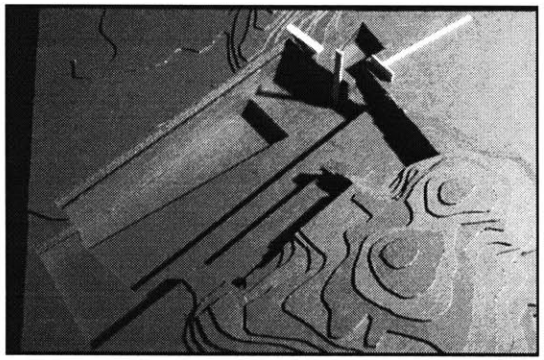


figure 46.1

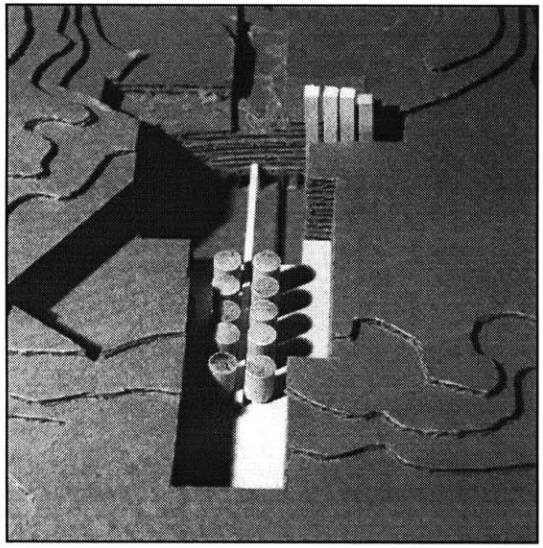


figure 46.2

EARLY QUARRY DESIGN

Initial attempts to plan the design of the quarry (figs. 46.1 and 46.2) were discarded due to the chaotic and unpredictable nature of quarry blasting. An idealized quarry, defined as a simple volume to house the burial ground, was utilized.

of the burial ground. The replacement of the ground's topsoil to the floor of the quarry places additional importance upon the definition of the land as a source of product. Additionally, the land is revealed for what it is—a commodity—and not a "natural" site consecrated as hallowed ground.

The use of the void as a sacred zone does not limit future use of the cemetery land. Most land, once consecrated for use as a cemetery, cannot be utilized for any other purpose.[6] Use of the sky as a sacred zone allows the possibility of relocating the columbaria if future development of the quarried land occurs.

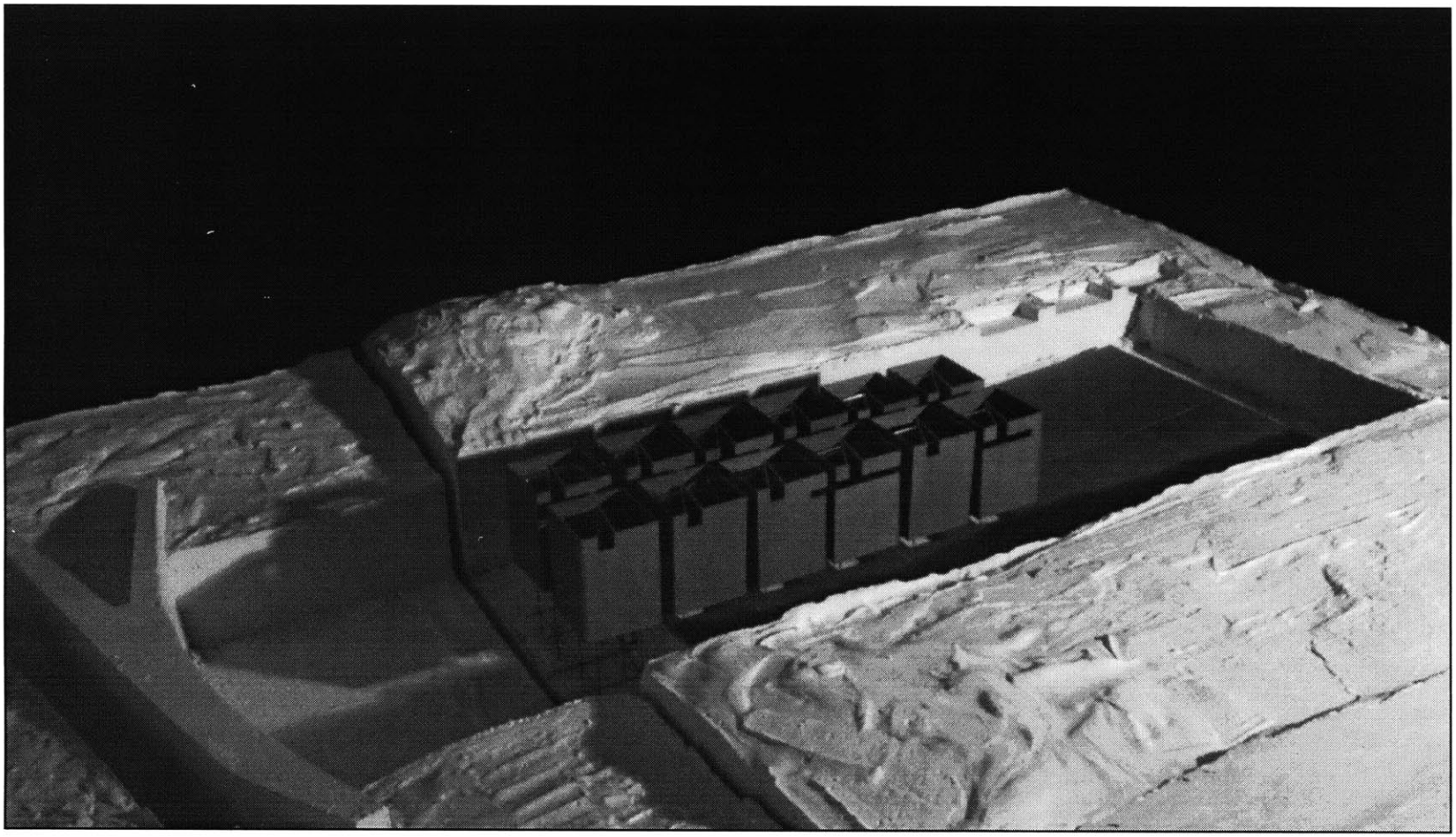
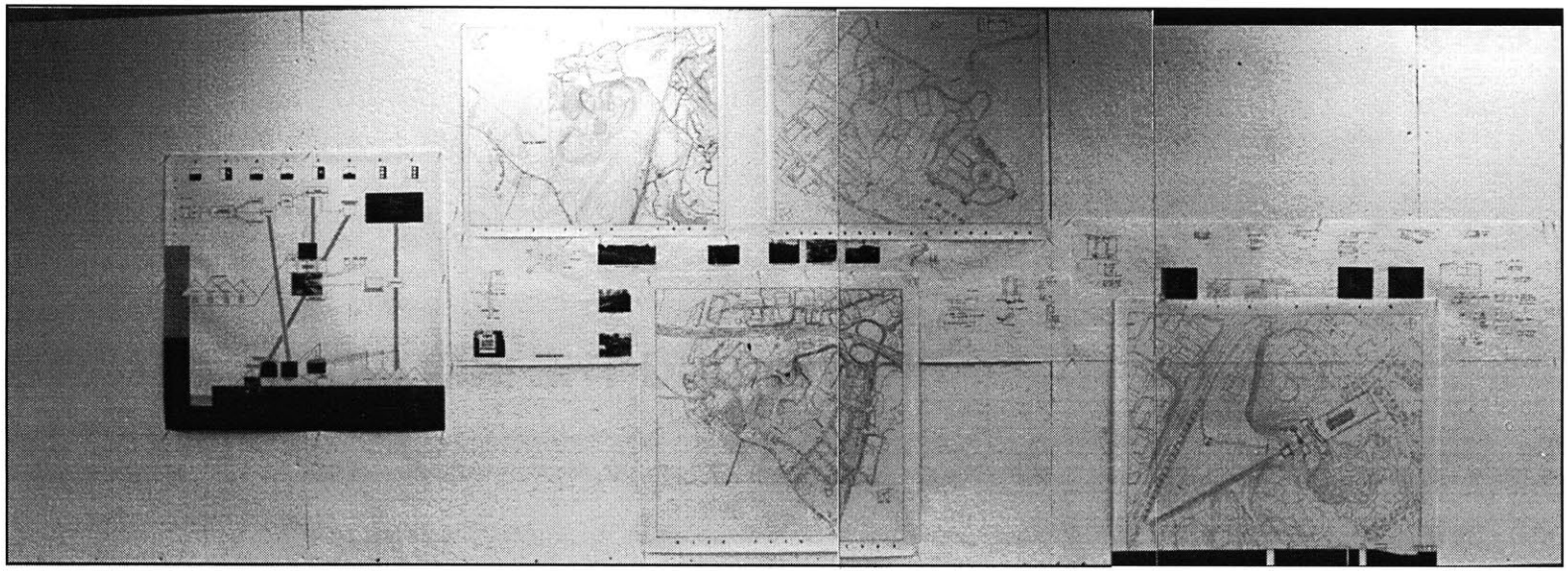


figure 47.1. Sacred void of the quarry.
The quarry wall closest to the old cemetery is defined by a great concrete embankment. The embankment formally separates the burial ground from the road leading into it, and the crematory to the west.

PRESENTING THE INDUSTRIAL CEMETERY

site plan 1952 proposed extension



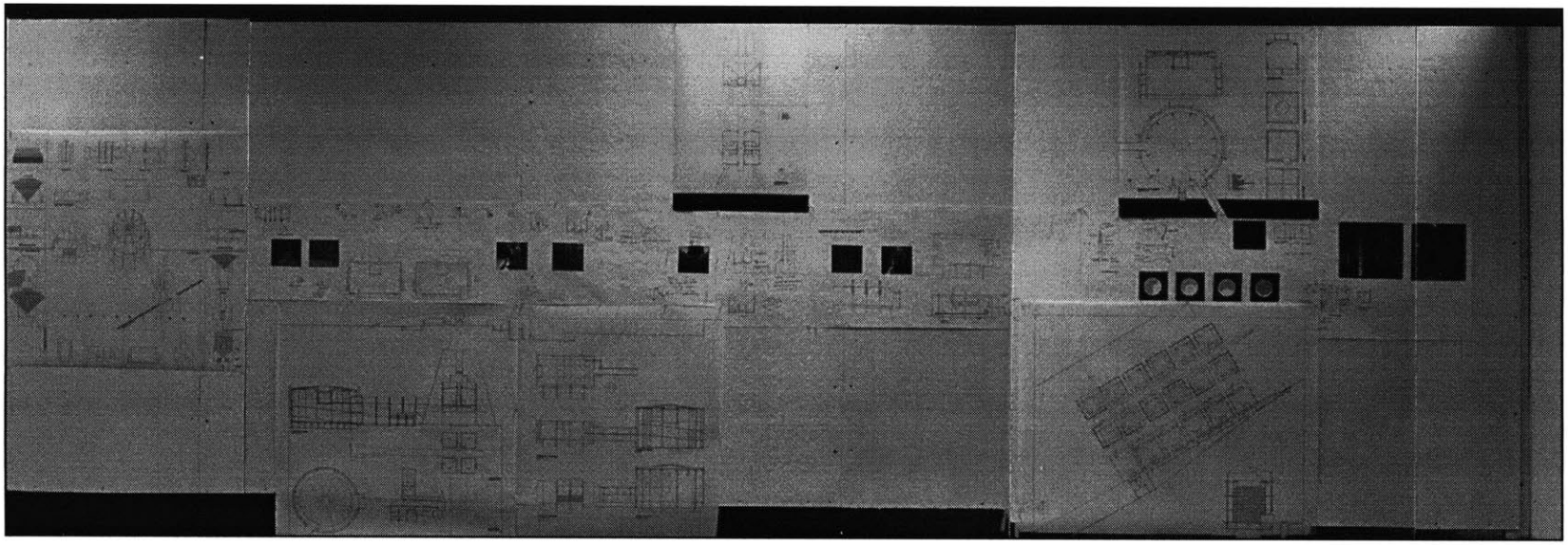
ritual / sequence site plan 1995 thesis site plan

HARVESTING
crematory

HARVESTING
chapel of shadows

HARVESTING
chapel of light

light as structure



TAPESTRY OF THE INDUSTRIAL CEMETERY

figure 51.1

harvesting diagram

INITIAL DESIGN SOLUTION
chapel of light
chapel of shadow
crematory

columbaria

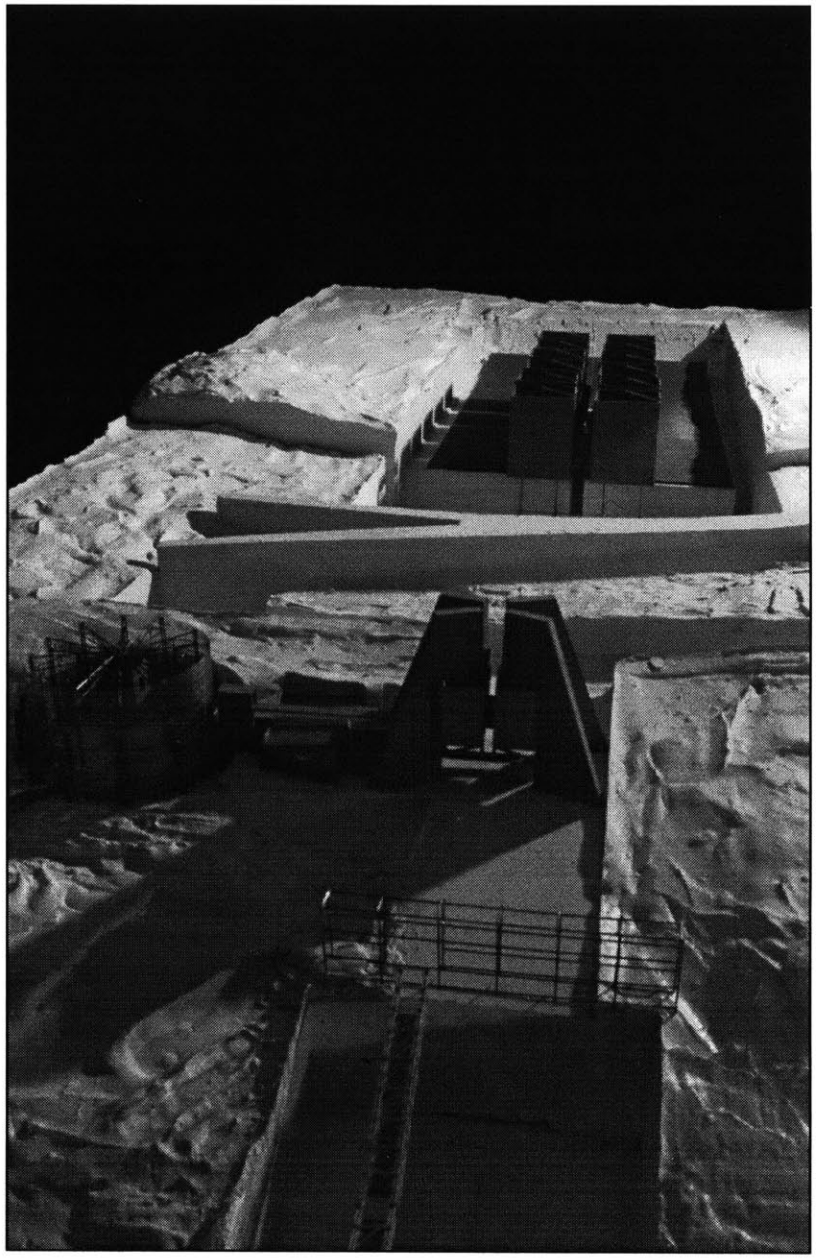


figure 52.1 Crematory complex and burial ground, looking west.

THE PRESENTATION

The next section of this book explains the thesis project as it was presented and conceived in its final form--a tapestry of computer images, sketches and ink on mylar drawings 36 feet long and seven feet high.

As one moves from left to right across the tapestry, the central band depicts the investigation of Harvesting Light. This band is broken up into two parts, which are divided by the Harvesting Diagram.

The tapestry left of the diagram depicts information that sets the foundation for Harvesting Light--site information, early conceptions of the nature of processing light,and the Ritual / Sequence diagram. This diagram was critical for investigating the industrial aspect of the funeral ritual and the human nature of industrial sequences.

The tapestry to the right of the Harvesting Diagram depicts the buildings in the project--the original designs from the first semester are below the central band, and the redesigned, light harvesting buildings appear above the band. Computer images appear in a single band inside the harvesting scroll. They tie the sketch explorations of light to the final realization of buildings which harvest light.

Additional information concerning this manner of presentation and its generative device, the Bayeux Tapestry, appears in Appendix C.

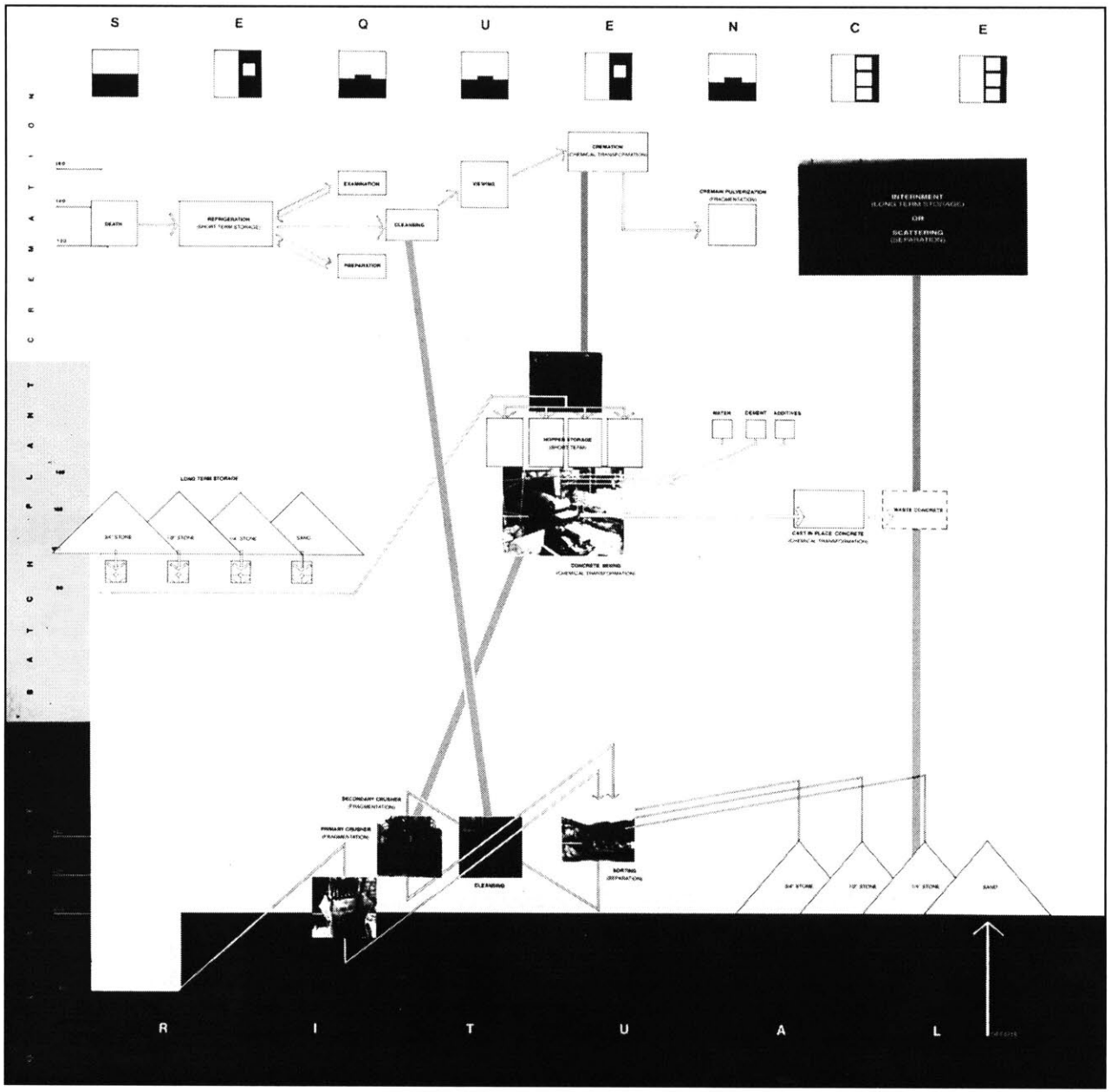


figure 54.1. Ritual / Sequence Diagram.

This diagram graphically describes the relationships between the three sequences considered in this thesis: quarry excavation, concrete batching, and the cremation funeral ritual.

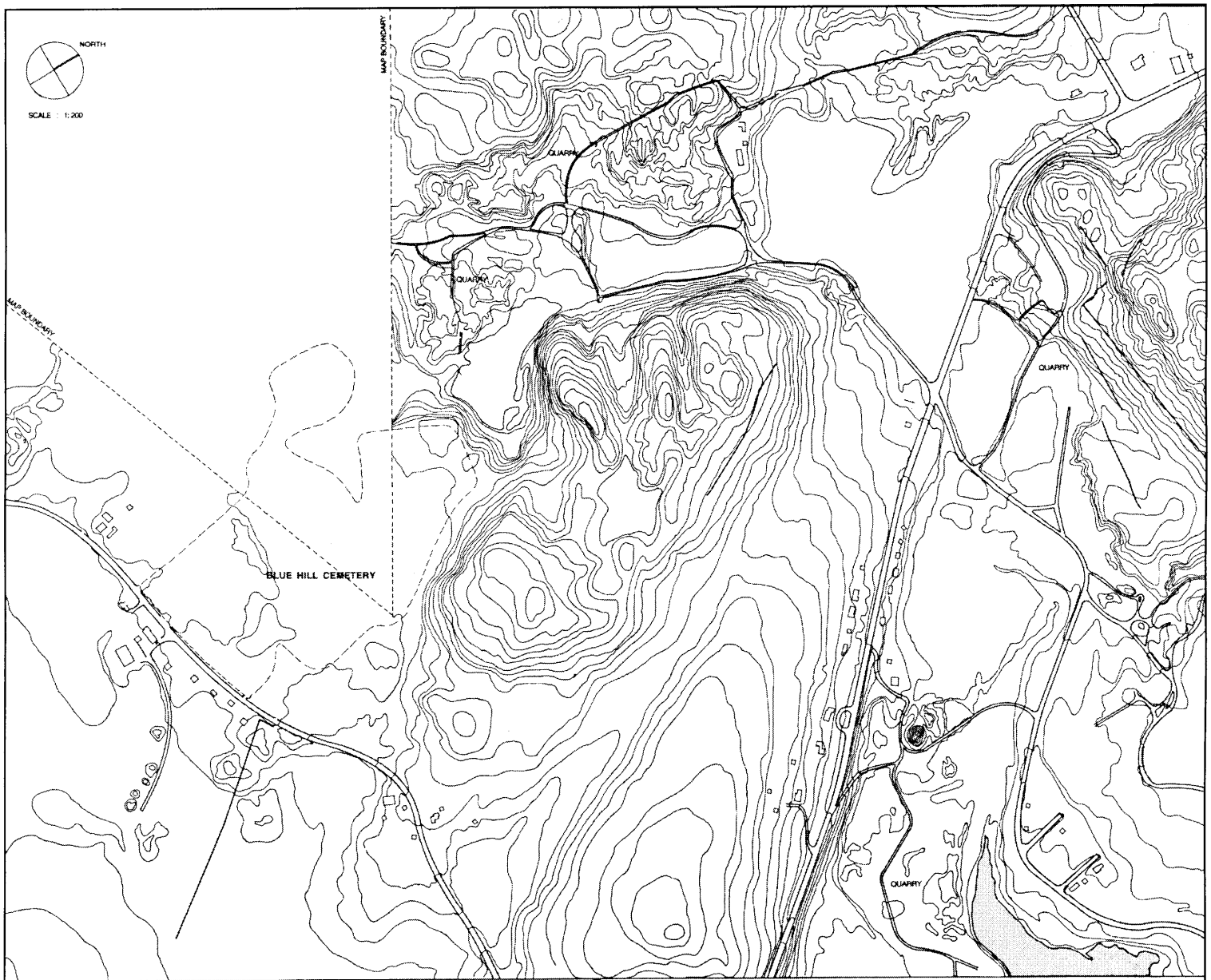
The Ritual / Sequence diagram purposefully questions the distinction between ritual and sequence; however, the difference between the two is clear. A sequence is merely a series of events that occur in a linear, determined order, while a ritual is a series of events of a ceremonial nature. Additionally, a process (such as concrete batching) is considered to be a series of events designed to create a product.

Gray lines connect steps in each sequence which have a strong conceptual relationship to each other. For example, the steps of incineration (Cremation Sequence) and mixing (Concrete Batching) are linked because the product of each sequence undergoes a chemical transformation. Incineration transforms a body into ash; the mixing of aggregate, sand, Portland Cement and water begins an irreversible reaction that ends with hardened concrete. Additionally, the nature of these two steps are diametrically opposed (fire and water). Conceptual relationships of this type are manifested in the crematory complex.

The process of Light Harvesting (fig. 73.1) provides the humanizing link between process and ritual, as processes are about efficient, mechanical production. Light (or its absence) is not a requirement for a process, but it certainly may be for a ritual. Processing light permits the humanizing of a process and contributes to the creation of ceremonial spaces appropriate for a funeral ritual.

Information on the processes of cremation, aggregate processing and concrete batching appears in Appendices A and B.

ritual / sequence
DIAGRAM



S I T E P L A N 1 9 5 2

The 1952 site plan reveals the extent of industrial activity that has taken place near the cemetery. The existence of several quarries can be seen; additionally, the surrounding land has not been highly developed, and the original topography is visible. Most of the major intrusions against the contemporary cemetery--Interstate 128, the industrial park, and the drive-in theatre--do not exist.

blue hill cemetery

1952

figure 57.1. (facing page). Site Plan of Blue Hill Cemetery, 1952.

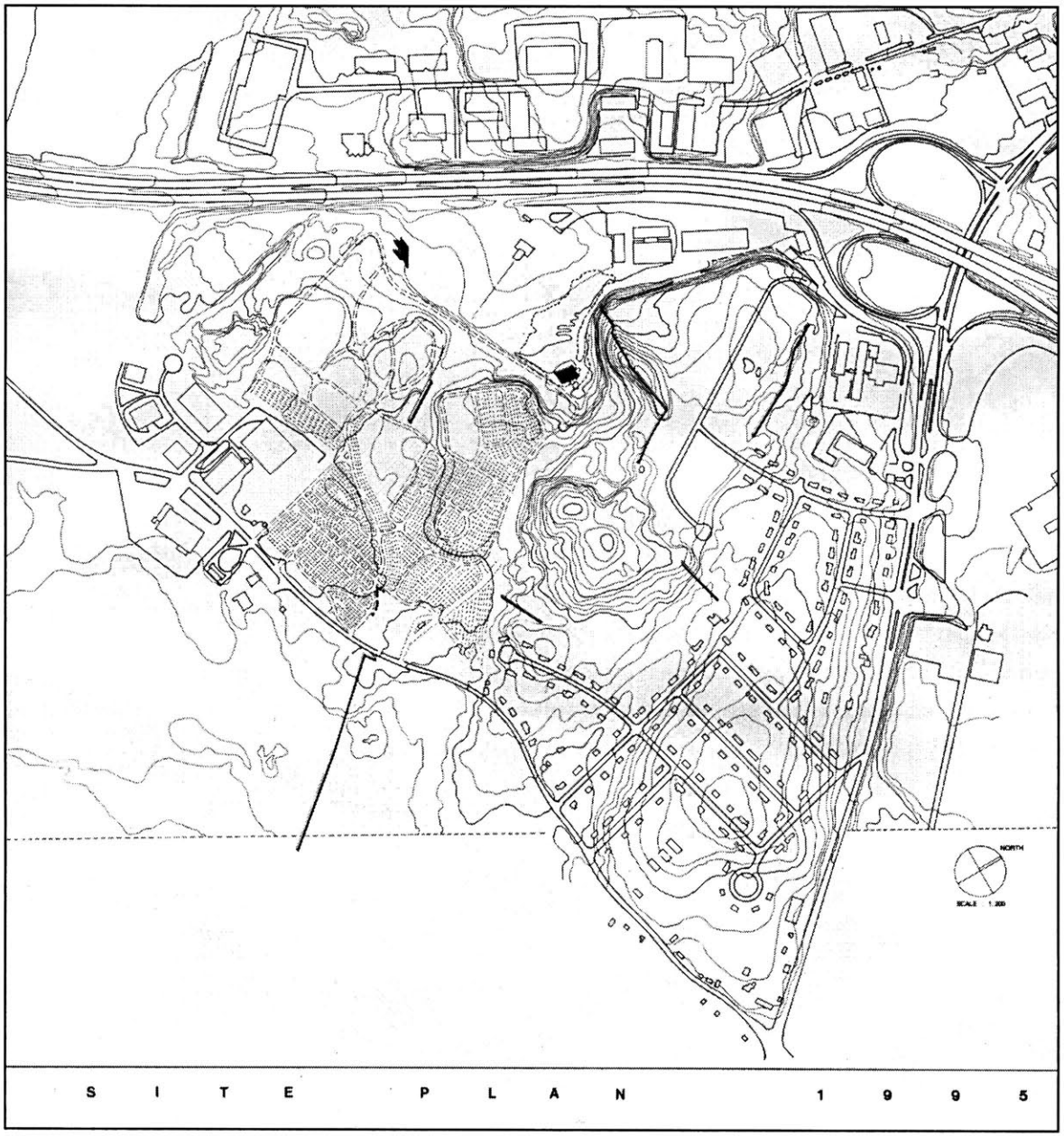


figure 60.1. Site plan of Blue Hill Cemetery, 1995.

blue hill cemetery

1995

The extent of development around Blue Hill Cemetery is revealed in this plan. The conditions depicted do not include the excavation for the new cemetery extension. Discussion of the site conditions surrounding the contemporary cemetery begins on page 17.


P R O P O S E D E X T E N S I O N

The proposal to extend the Blue Hill Cemetery is a continuation of the existing network of meandering, garden-style cemetery fabric. The western arm of this extension attempts to create an axis with formal grave sites, a central statue and a reflecting pool. However, the absence of any existing axis makes this gesture problematic.

The extent of the excavation into the hillside can be seen in this drawing. The southwestern edge of the new extension will be problematic for the residential subdivision, as the backs of both areas will be in direct proximity to each other. Additionally, the northern perimeter road is shortened without addressing the problems of its boundary condition.

blue hill cemetery

proposed extension

figure 60.1. (facing page). Proposed extension for Blue Hill Cemetery.


S I T E P L A N
ASCENSION PATH
CHAPEL
CREMATORIUM

new crematory and burial grounds

site plan

This site plan is the final design solution for the thesis project. Mediation of the northern boundary of the old cemetery is clearly evident, and the new entrance to the cemetery extension is clear. The smaller, secondary road through the aggregate field leads directly to the old cemetery.

The crematory complex is nestled between the two summits of the hillside. It conceals the burial ground from visitors until they havechosen to enter the complex. Once a visitor reaches the final walkway to the crematory retorts, the quarry void is revealed.

The bottom of the drawing depicts the Ascension Path. This path is the extended approach along the main road towards the complex,and the journey upwards through the chapels in the complex.

figure 62.1. (facing page). Site Plan for the Industrial Cemetery.

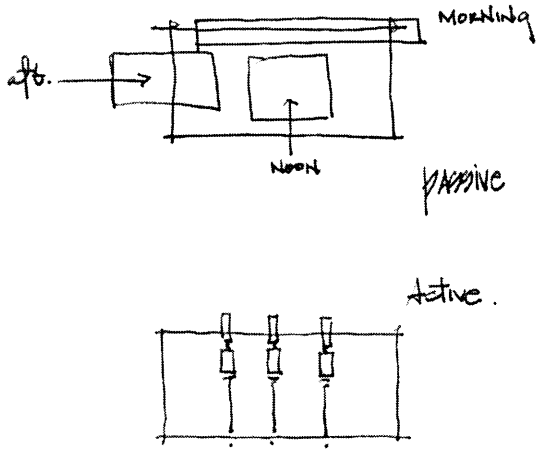


figure 64.1. Sketches, Chapel of Shadow.
These sections hint at the first ideas for defining zones of harvesting light, and the methods of Passive and Active Harvesting.

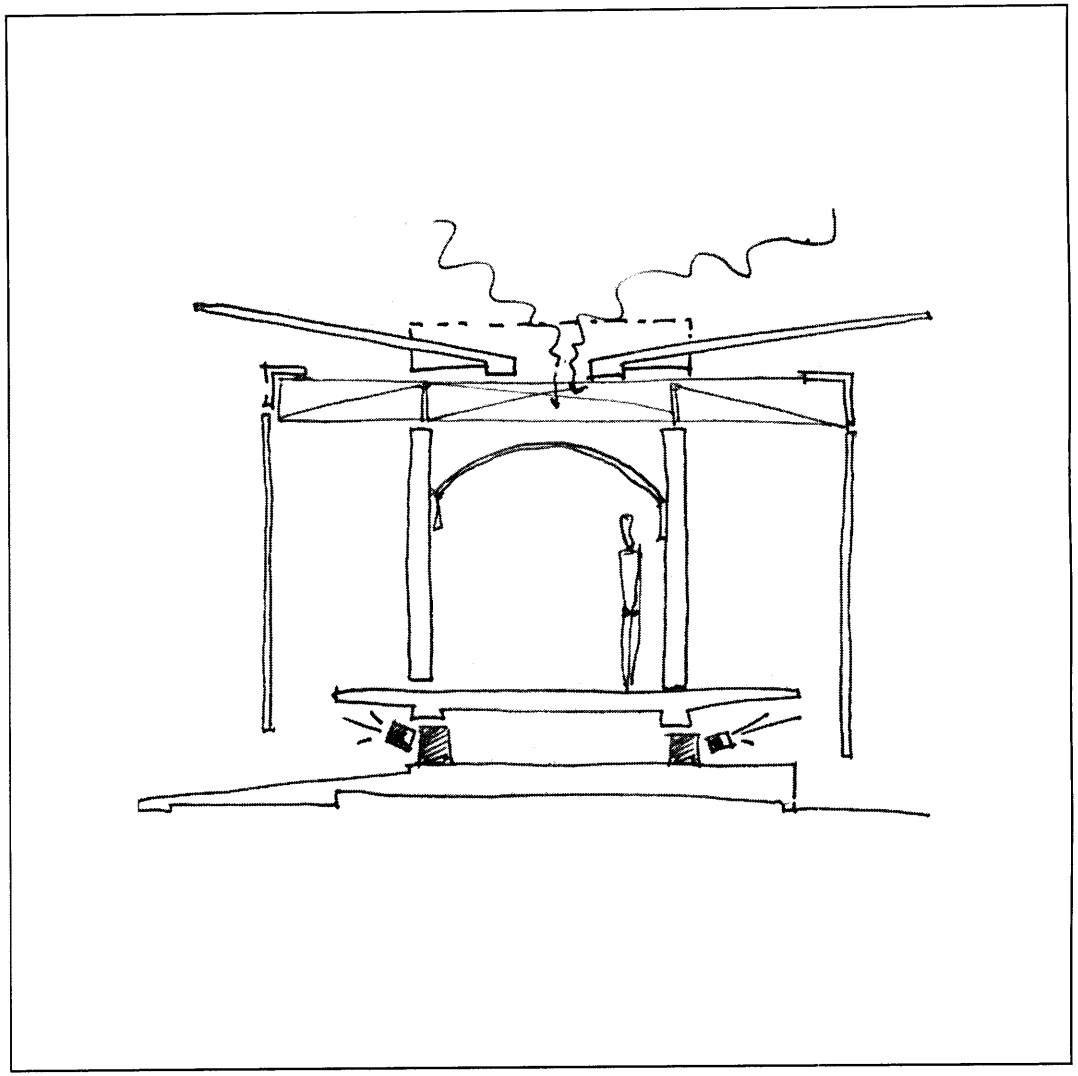


figure 64.2. Section through Chapel of Shadows, looking west.
This sketch shows the first manifestation of a form which processes light in an Active manner. By inverting the roof's pitch, a slit in the center is created to admit light to the chapel's interior. The roof shape becomes a "hopper" for light. It also begins to suggest a manner for artificially lighting the chapel.

harvesting light

Chapel of Shadow
early intentions

Early investigations of harvesting light began in the Chapel of Shadows. The initial intention was to discover a method to admit light into the Chapel by utilizing the structure of the building to define the "form" of the light. The section depicting light as it passes through the roof (fig. 64.2) was the first realization of processing light. Computer models tested the quality of the interior space at various times during the day and revealed opportunities to change the nature of the space. This led to the definition of three zones of harvested light: morning, afternoon and evening. The forms of the Chapel were then developed to reflect the harvesing of the enclosure.

Harvesting Light on the Equinox

The hopper roof, adapted from an earlier sketch, acts in conjunction with the steel enclosure to define zones of illumination. The nature of the chapel changes greatly over the course of the day. At this stage of design too much ambient light is permitted to enter the chapel. Breaks in the enclosure between the roof and steel enclosure wall admit the excess ambient light. These conditions were later refined to create an appropriate atmosphere for the chapel.

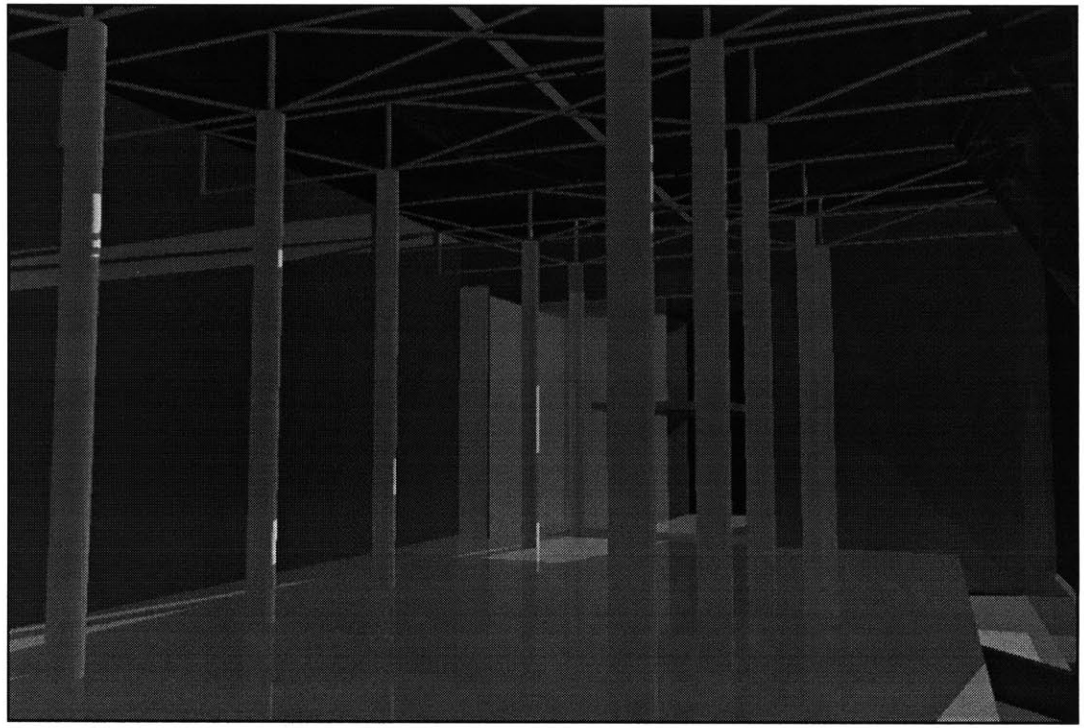


figure 66.1. Chapel of Shadows, view west, 0900 hours
Light enters only through the threshold chamber connected to the Chapel of Light. The slit in the roof runs the entire distance of the roof plane, and does not reflect later delineation of the morning harvesting zone.

figure 67.1. Chapel of Shadows, view west from altar, 1200 hours
Light enters through apertures in the southern wall. These apertures were designed with a screen of louvers to reduce incoming light. This image reveals the depth of the light's penetration into the interior. These apertures were refined into the Shadow Windows.

figure 67.2. Chapel of Shadows, view southwest, 1700 hours
Apertures in the western wall permit light to play through the upper zone in the chapel, which originally contained a truss system. The apertures were later designed with frosted glass panels to reduce the intensity of late afternoon light entering the chapel.

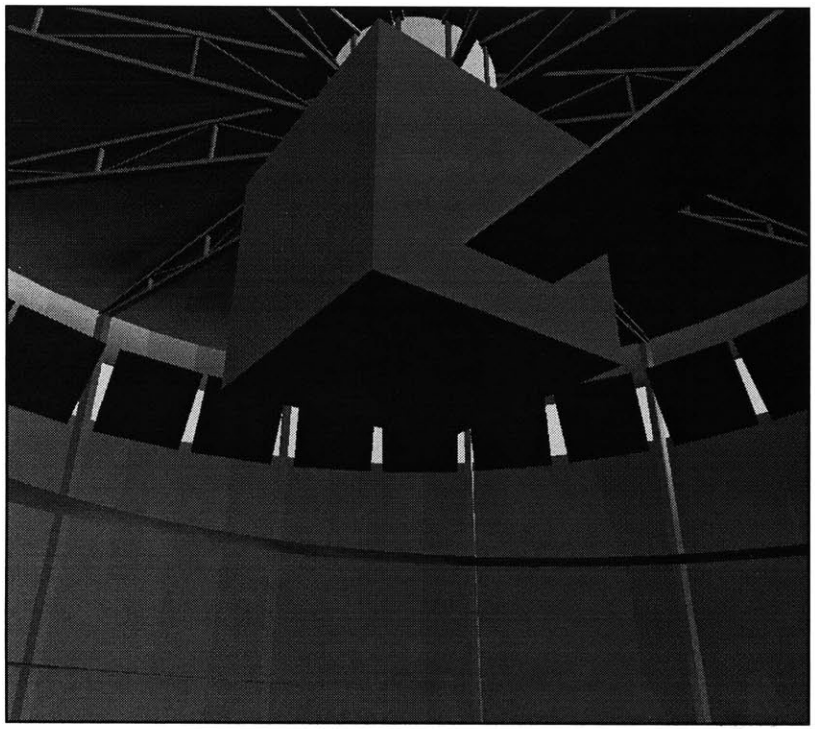


figure 68.1. Chapel of Light, interior view towards Floating Chapel.
Early design attempted to illuminate the interior by reflecting daylight into the ceiling dome. The sloped panels would reflect incoming light, and light entering through the oculus would reflect off of the Floating Chapel. These methods did not admit enough light into the chapel, and prompted additional study of the chapel.

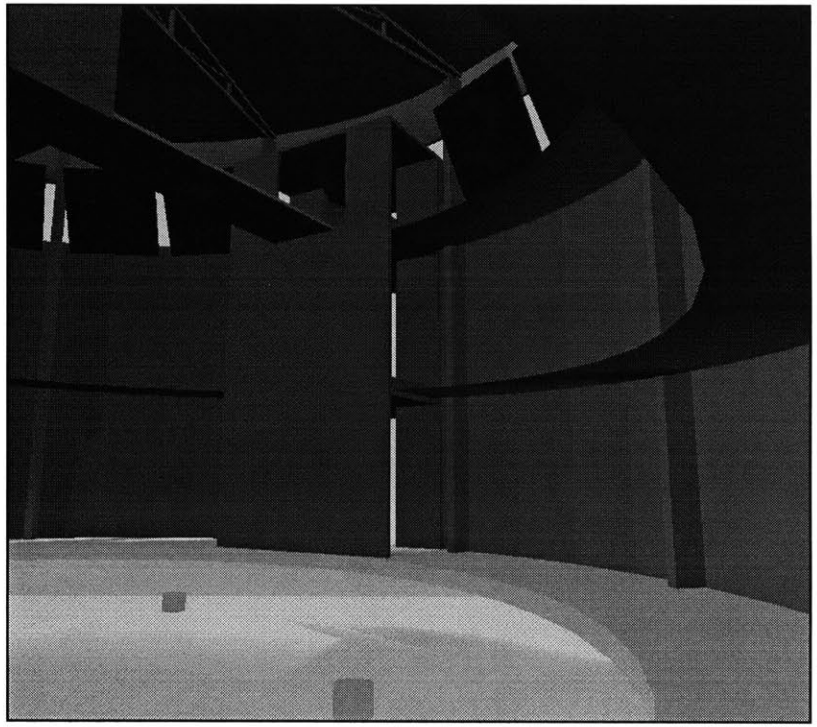


figure 68.2. Chapel of Light, interior view towards crematory entrance.
The ascension ramp was originally placed inside the chapel drum, and threshold pavilions intruded into the drum's volume. The onyx floor, which admits artificial light by virtue of its translucency, occupies the center of the chapel. Later schemes relegate the ramp to a position outside of the drum in order to retain the purity of the drum's form.

harvesting light

Chapel of Light
early intentions

The Chapel of Light had been conceptualized as a mixing chamber for natural and artificial light. In effect, it was a "thermostat" that combined steady artificial illumination with the changing natural light during the course of the day.

The computer model depicted in figs. 68.1 and 68.2 revealed a fundamental error with the chapel's initial design : the apertures did not admit enough light into the interior. The small chapel did not "float" in a space defined by light; nor did light mixing occur.

The purity of chapel's drum-like interior was also compromised by threshold chambers entering the space and the ascension ramp. Fundamental redesign was necessary.

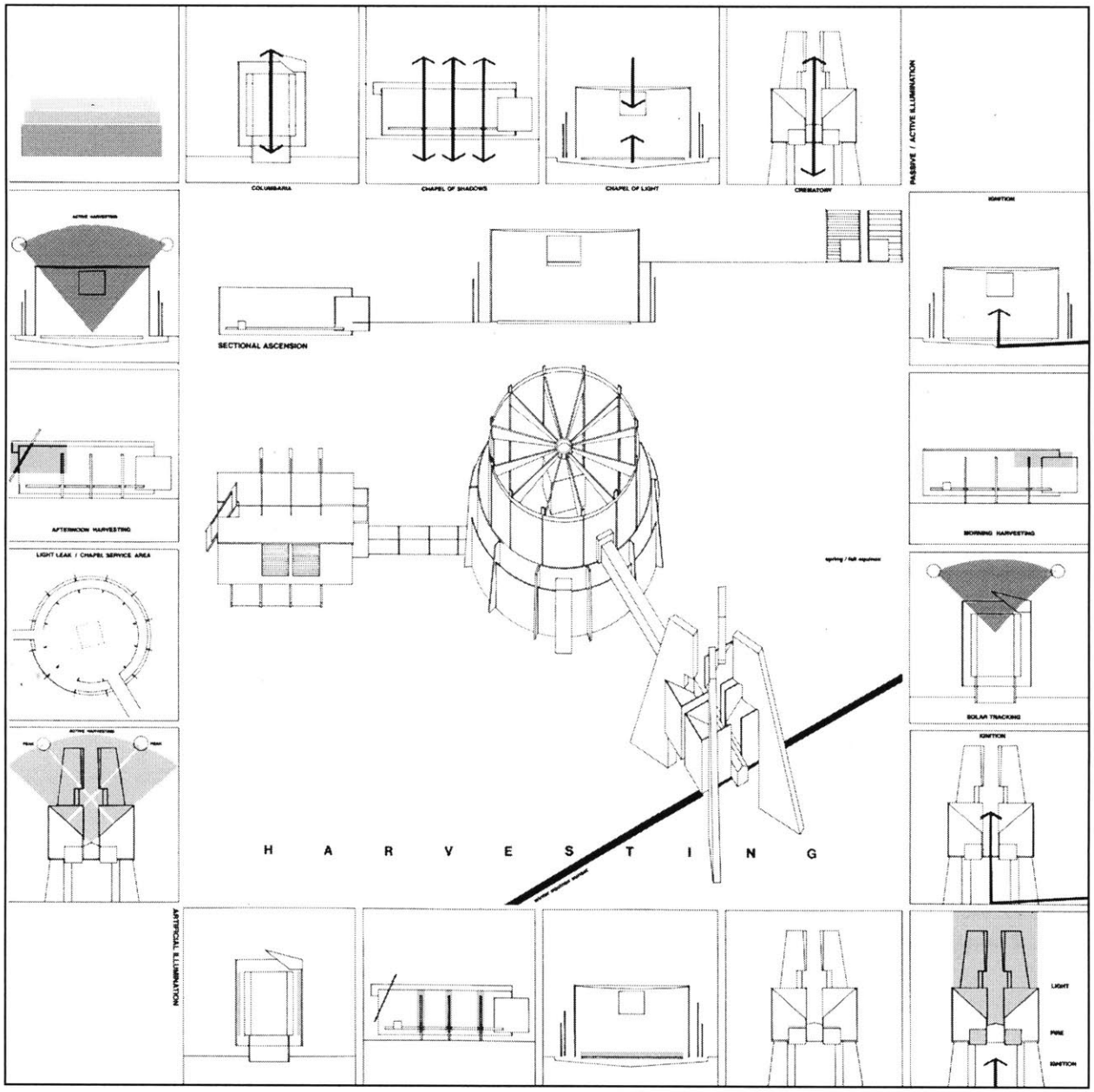


figure 70.1. Light Harvesting Diagram.

This drawing describes the methodology of Harvesting Light. The eighteen diagrams which surround the larger drawing of the crematory and chapels are organized in two ways: by association with the diagrams in each border of the drawing, and across the drawing. Four buildings in the complex were designed to process light: the Chapel of Light, the Chapel of Shadow,the crematory, and the columbaria.

The upper border diagrams reveal Active and Passive harvesting methods in each structure. The right and left bands are paired across the drawing: the left side diagrams reveal midday or afternoon harvesting, while the right side reveals morning harvesting and acts of "ignition." Ignition is the conceptual act of the sun's first rays beginning the light harvesting routine; the Chapel of Light and the crematory are designed to take advantage of early morning light in this manner.

The lower border diagrams reveal acts of artificial illumination within the buildings. Artificial lighting in the buildings is sympathetic to the harvesting ritual, and is incorporated into the processing of light to reveal some aspect of each structure.

The upper left corner diagram depicts "waterlines" in the Chapel of Light; these are defined by the chapel's drums. The lower right corner diagram shows the conceptual relationship between ignition, fire and light as a phenomenon of ascension in the crematory tower.

harvesting light

DIAGRAM

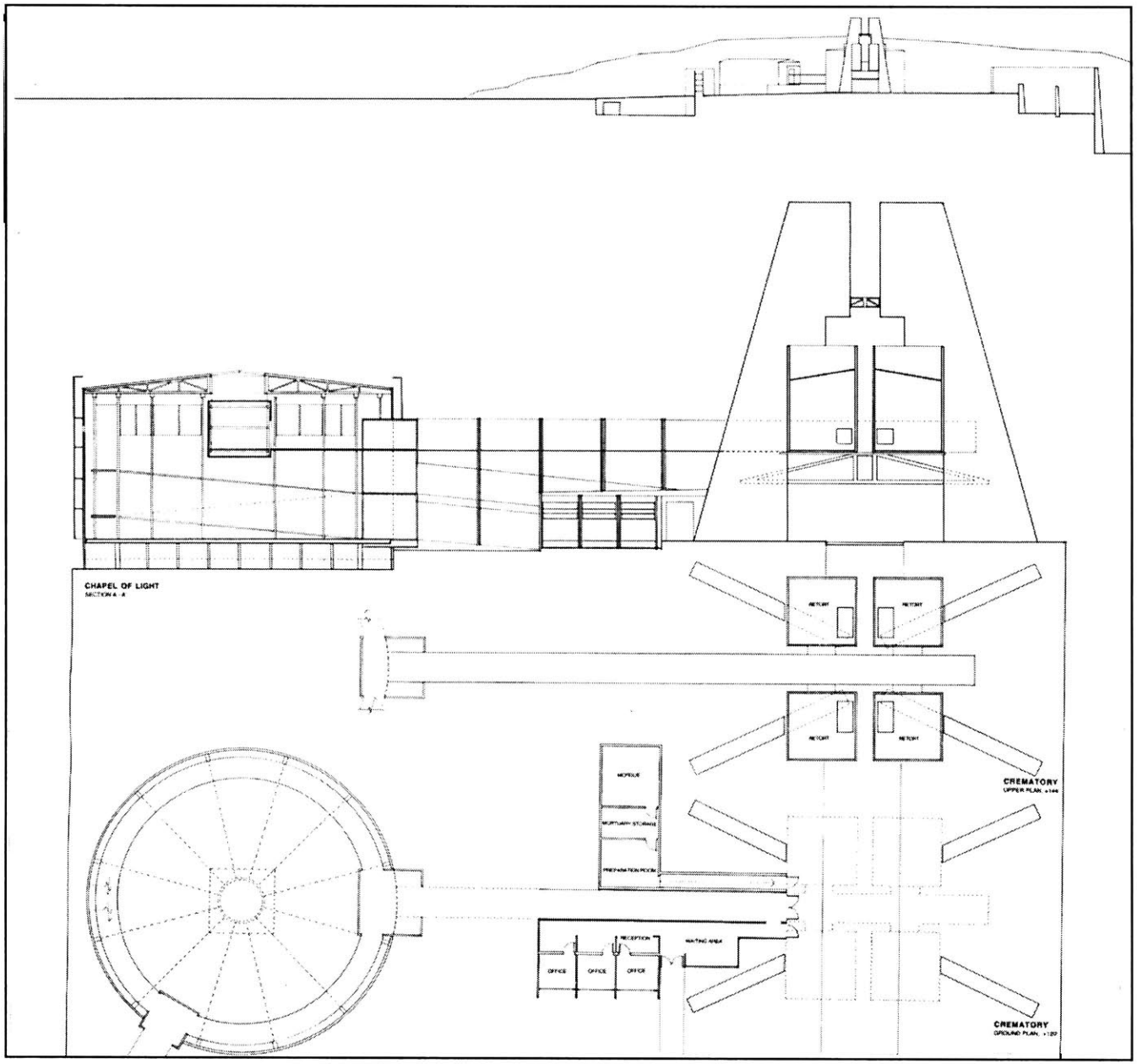
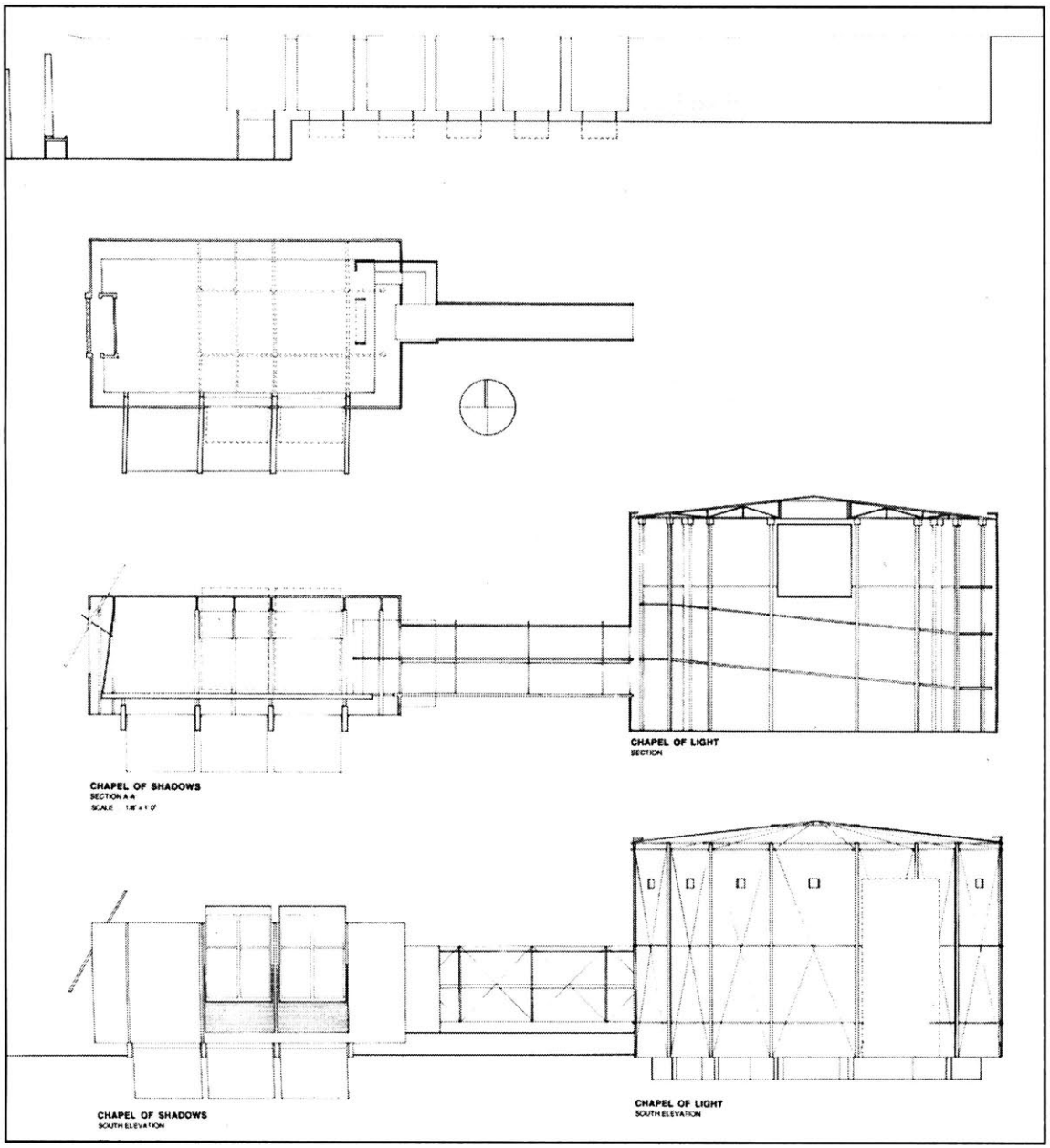


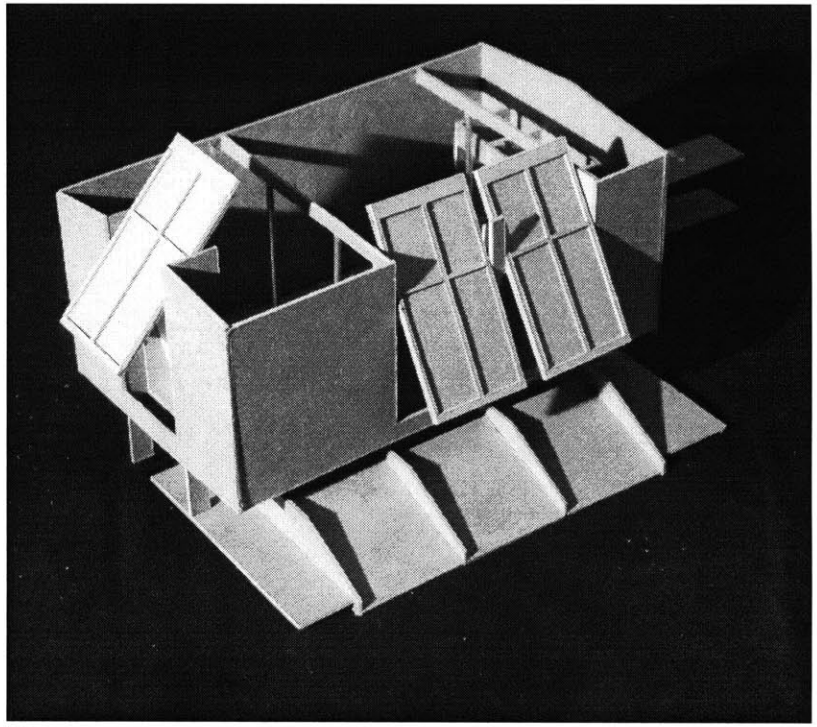
figure 72.1. Initial design drawing, Spring 1995.



initial design

CHAPEL OF LIGHT
CHAPEL OF SHADOWS
CREMATORY

figure 73.1. Initial design, Spring 1995.



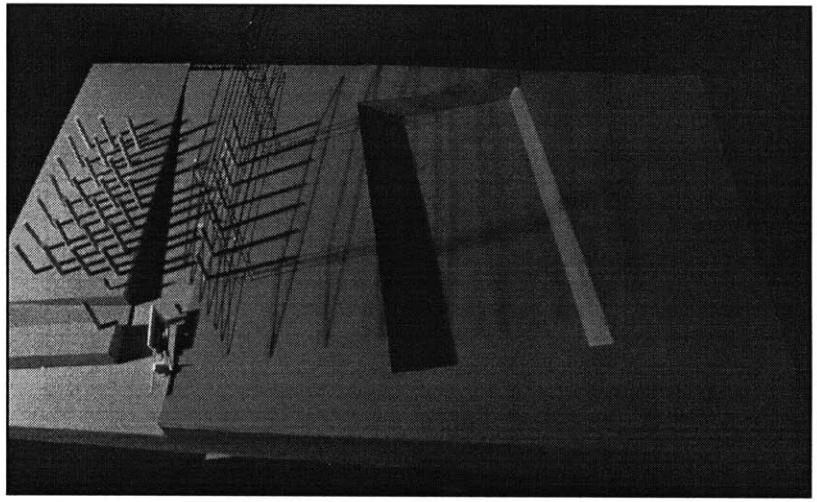
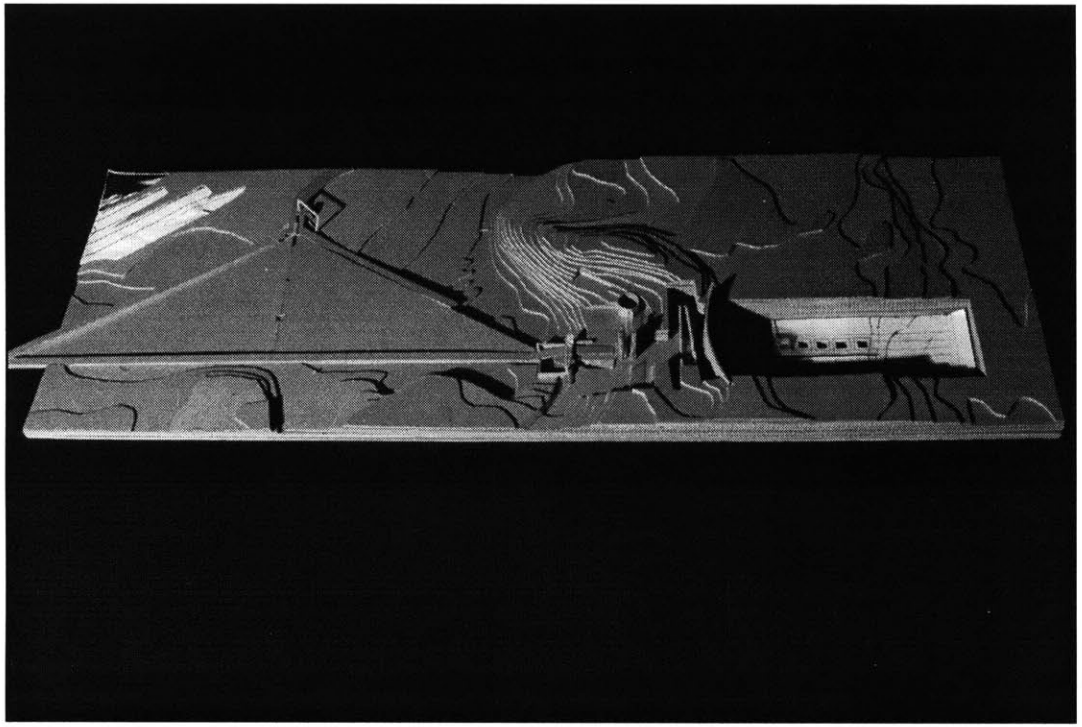


figure 74.1 (top). Chapel of Shadows, 1/8" scale model, spring 1995.

figure 74.2 (bottom). Entry sequence and drive-in movie screen, design study.



initial design
MODEL STUDIES

figure 75.1. Site model, 1:100 scale, spring 1995

*figure 76.1. **Light filtering of Shadow Windows and roofplane.***
The Shadow Windows contain mobile louvers, which can deny or accept light into the chapel. This iteration of the chapel contained several experimental shadow-casting' systems (louvers, exterior panels, interior vaulting).

*figure 78.2. **Artificial Illumination Scheme, night.***
The sources of light are concealed beneath the floor slab and atop the structural columns.

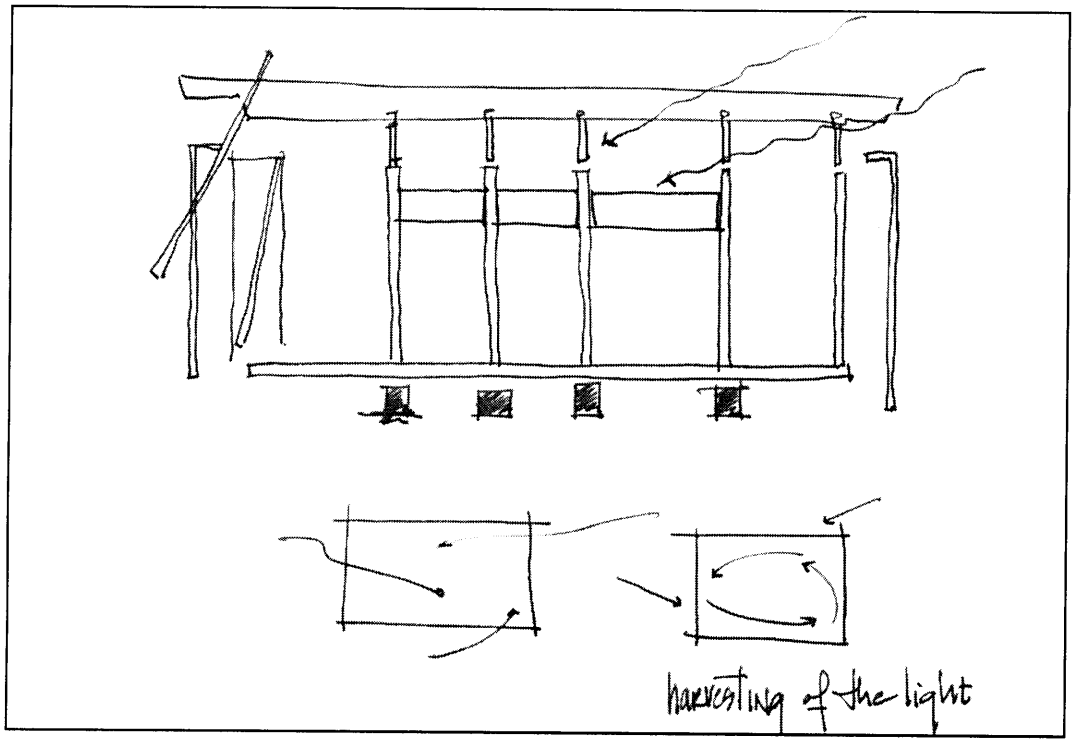
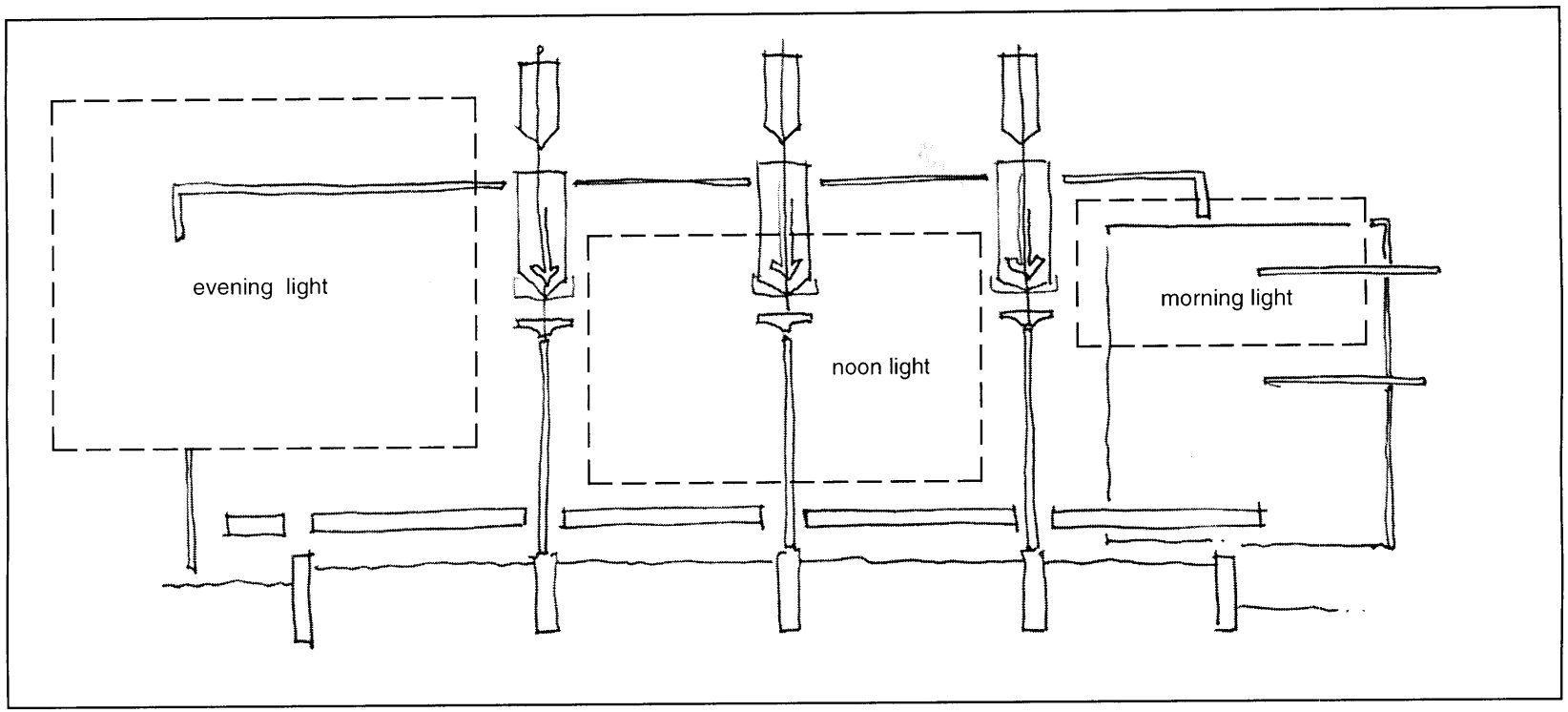


figure 77.1. Cyclical nature of light harvesting, Chapel of Shadows.

The second iteration of the Chapel of Shadow realized a tighter defintion of light harvesting in its spaces, and the potential cooperation of artificial and natural lighting in a scheme of shadow creation.

Active processing of light became a priority, spawning a design for columns that strictly harvest light (fig. 79.1). Light and color were investigated as methods for moving people into and through the chapel (fig. 79.2 and 79.3).


evening light
noon light
morning light

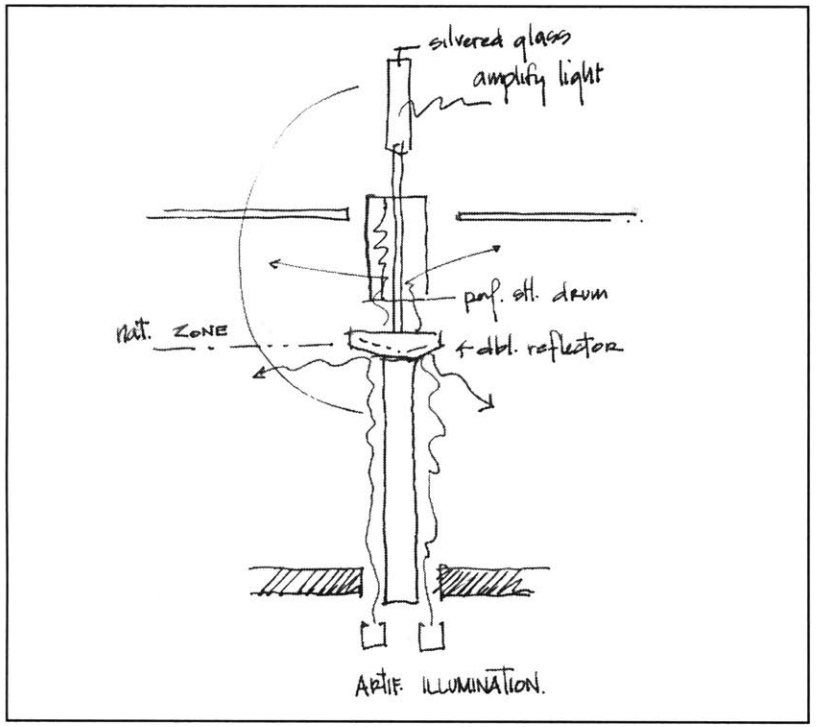


figure 78.1. (facing page). ***Refined system of cyclical and Active light harvesting , Chapel of Shadows.***

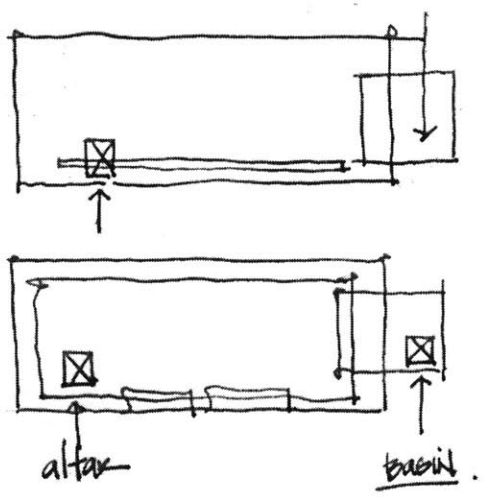
figure 79.1. (above, left). ***Column for Active light harvesting, detail.***

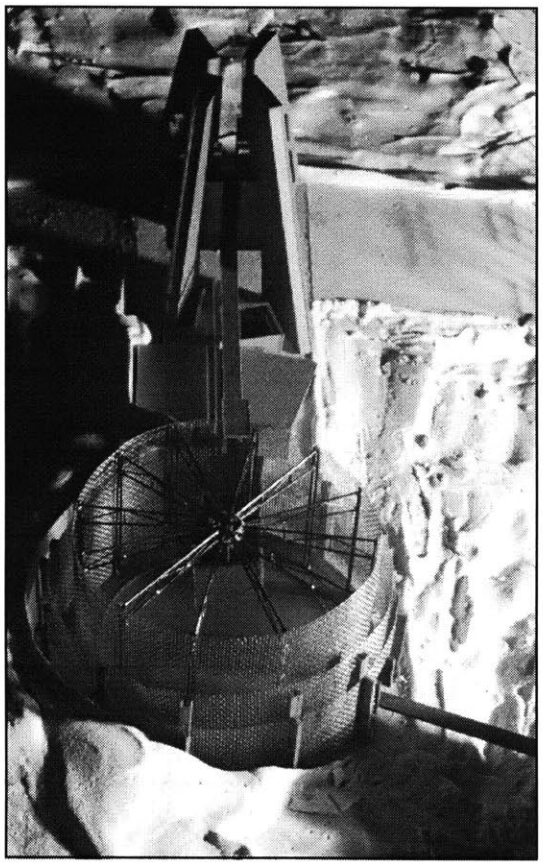
*figure 79.2. (above, right).**Morning light, Chapel of Shadows.*** *Combinations of light and color were examined as potential devices for moving people in and out of the chapel.*

figure 79.3. (right). ***Sketches, Chapel of Shadows.*** *These sketches reveal an early idea of using an illuminated altar and water basin as light devices in the shadows of the chapel.*

section

plan





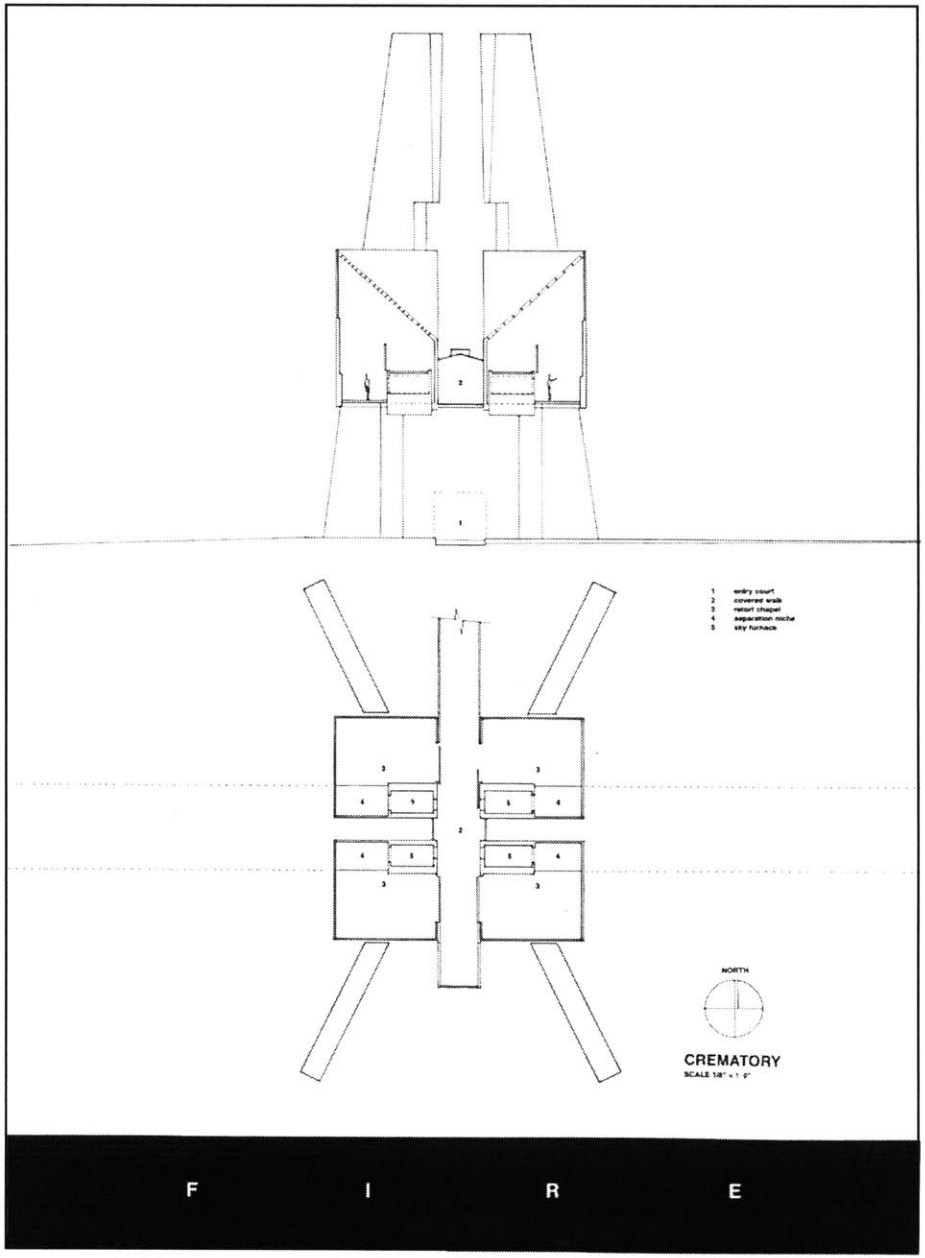


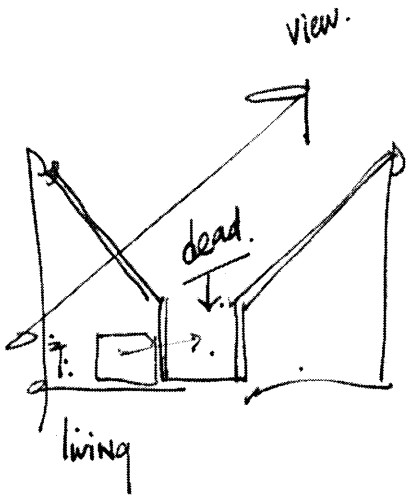
figure 80.1. (above). Crematory and Chapel of Light. view looking south, final model.

figure 80.2. (right). Crematory, final design.

The crematory tower is the conceptual and programmatic foundation of the new cemetery extension. It denotes the point of entry for both the living and the dead into the crematory complex. It is the final destination in the funeral ceremony, as it contains the retorts where bodies are cremated. Its form as an artificial mountain in the landscape references the theme of ascension to the sky, and its method of harvesting light recalls the memory of a concrete batching tower.

The crematory tower is formally defined by four concrete pylons supporting four retort chapels. It is located at an elevation of 140' above sea level, placing it above the entire old cemetery and in a commanding position in the landscape. The retort chapels are windowless chambers of metal, open to the sky only through steeply sloped, sieve-like roofs. North of the tower at grade are the crematory administration building and mortuary storage areas. A wall of glass blocks, a Wall of Light, physically separates the administrative areas for the living and the dead. North of the administration building is the Chapel of Light, which is directly connected to the crematory tower by a glass-enclosed walkway 24' above grade. The walkway leads directly to the retort chapels.

The tower's prominent position in the landscape makes it a landmark for the new cemetery. Its position also allows it to be the first part of the complex to receive the morning sunlight, and



harvesting light

CREMATORY
FINAL DESIGN

figure 83.1. Section through Retort Chapels. *The act of placing the body into the retort is the symbolic placement of the body into the sky.*

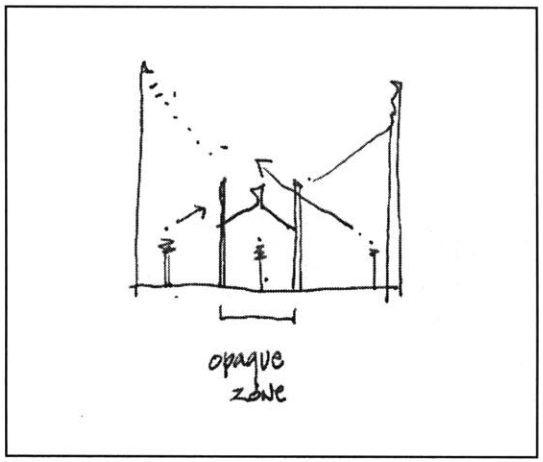


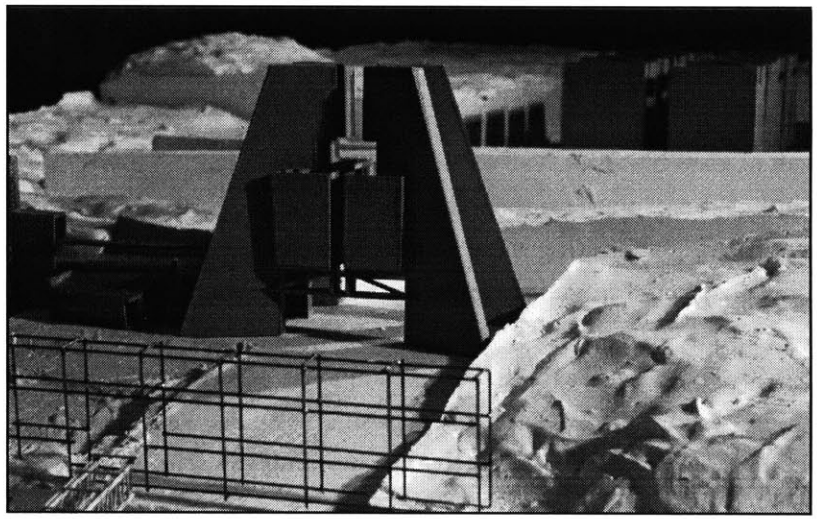
figure 82.1 (above). Crematory, zones of viewing and restricted view.

figure 82.2 (right). Crematory, view looking east over water wall. Final model.

conceptually the 'ignition' of the daily process of harvesting light begins here.

A narrow, shallow water-filled canal extends east from the tower towards an overlook into the quarry. The channel catches the first rays of the sunlight, reflecting them up to the bottom of the retorts—it is the conceptual "match" that begins the collection of light.

The retort chapels mark the point in the funeral ritual where the living and dead are permanently separated and closure to the ritual is provided. The retort's placement in each chapel creates a raised niche; the living must stand in this niche to place the body into the retort. The retort doors open vertically, and they block one's view of the ceiling when the body is placed in the oven. Once the door is closed, the view of the sky is revealed—in effect, the body has been placed into the sky. The process of ascension is complete.



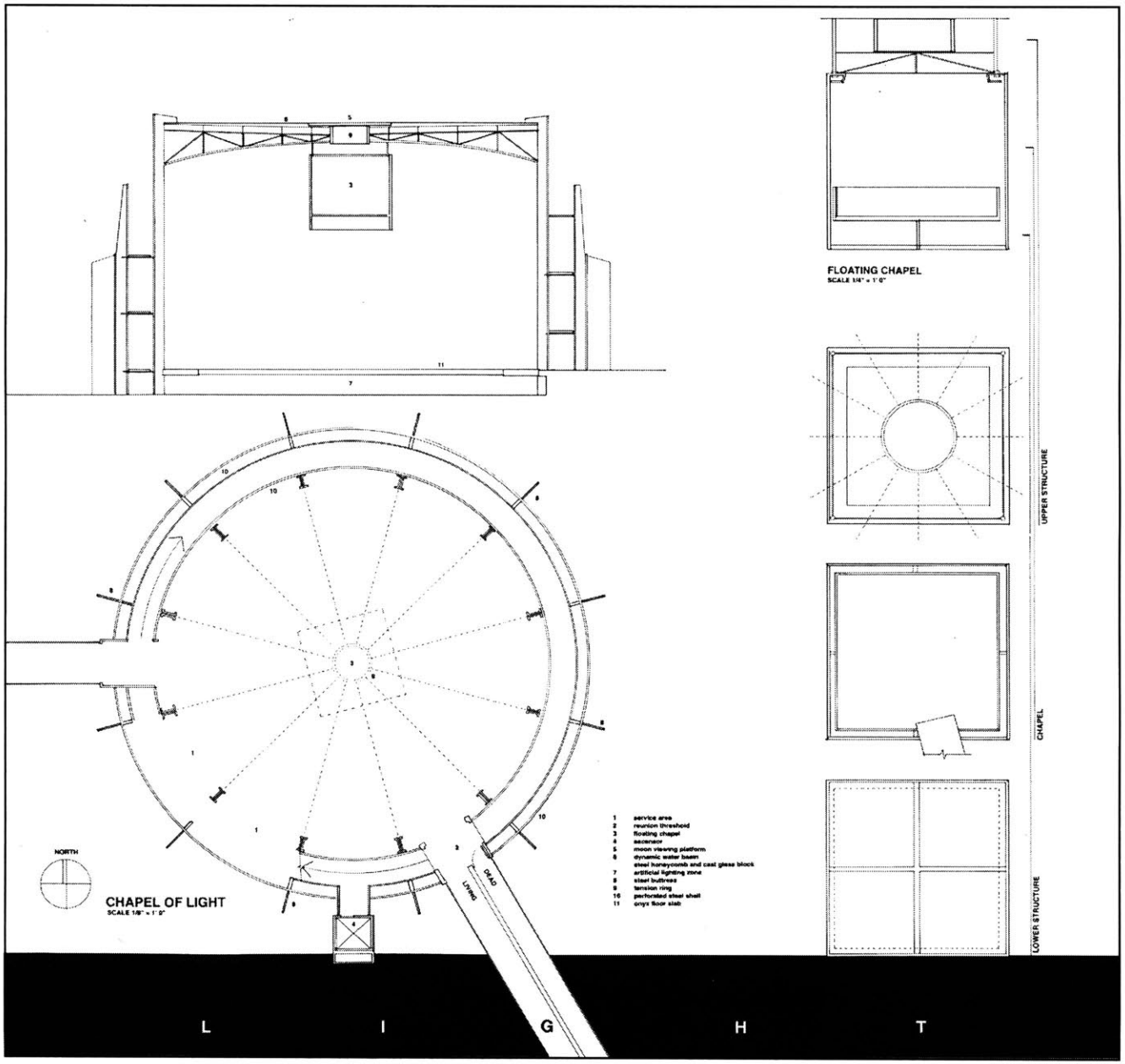


figure 84.1. Chapel of Light, final design.

The Chapel of Light is located at the "knuckle" of the crematory complex. It contains two spaces for ceremonies—one great drum-like chamber, and one of intimate scale. The primary route of ascension in the complex occupies the perimeter zone of the chapel. This route is a spiraling ramp that connects the crematory administration building, the Chapel of Shadows, and the walkway to the crematory tower. The chapel is a place of mixing and reunion—the living and the dead are reunited within the chapel, artificial and natural light combine in the space, and water provides a dynamic quality to the light harvested through the chapel's roof.

Structurally, the Chapel of Light consists of twelve compound steel columns, and they define the innermost of three concentric zones in the chapel. The columns are laterally braced by steel buttresses which also support the spiraling ramp. A series of twelve arched steel trusses span the 80' diameter chapel, and they are joined at the center of the chapel by a steel tension ring. An intimate Floating Chapel, a steel cube 18' on each side, is hung from the trusses.

The expansive truss system is necessary to support the Chapel of Light's unusual roof. The trusses support a round basin of steel plates fastened into a honeycomb structure. The hexagonal voids are filled by cast glass blocks, and a clear sealing resin covers the outer surface of the basin. Water is conveyed up to the rooftop

harvesting light

CHAPEL OF LIGHT
FINAL DESIGN

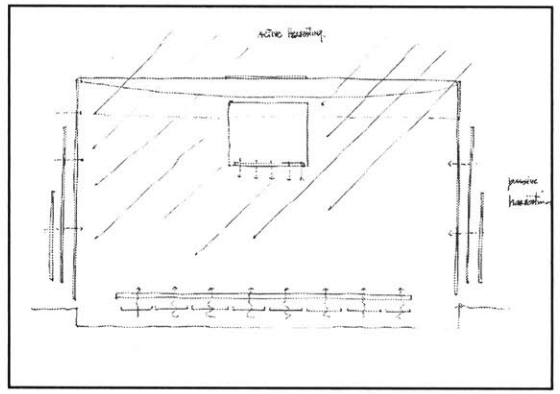


figure 85.1. Active / Passive harvesting sketch.

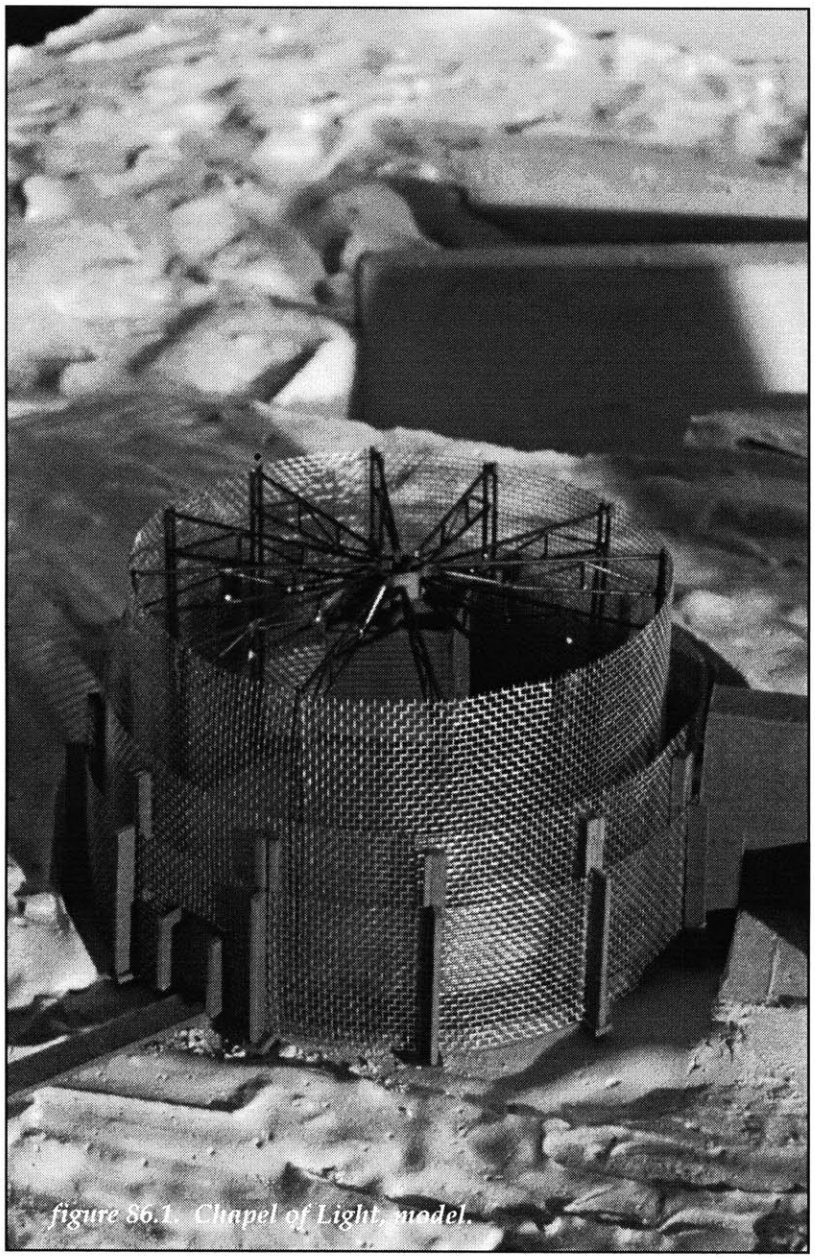


figure 86.1. Chapel of Light, model.

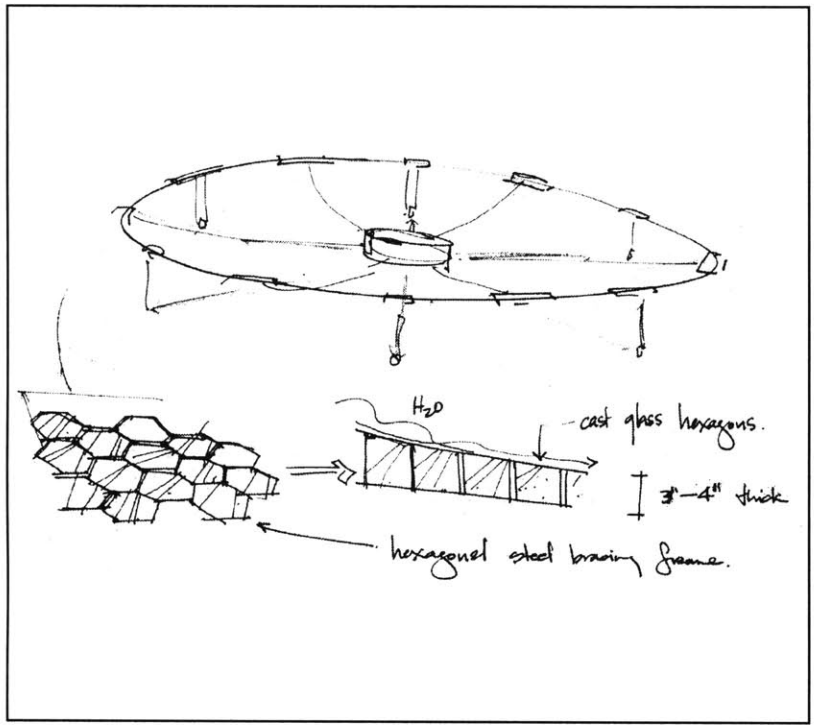
through six pipes in the chapel's columns, and it washes down and across the honeycomb basin to the center of the roof. The water is then distributed into six pipes in the hollow trusses, which return it to the ground via the other six structural columns.

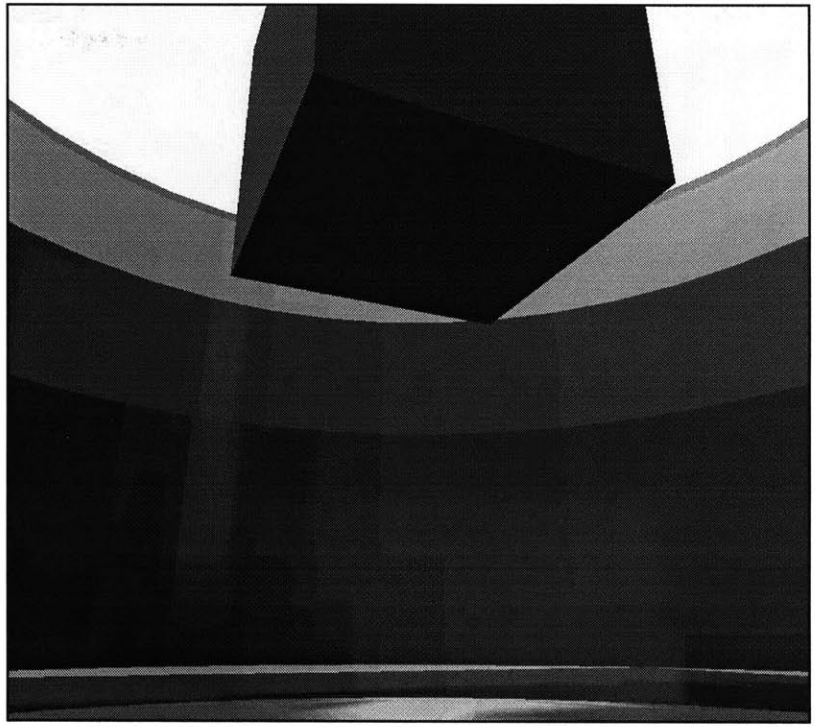
The enclosure of the Chapel of Light consists of three perforated steel drums of different height, with the innermost drum being the highest. The three drums separate the ascension ramp from the two ceremonial spaces. This permits different groups to utilize the procession of spaces within the crematory complex without disruption.

The only opportunity for view through the enclosure occurs at the ground floor of the chapel. The southwest corner of the drum is defined only by the outermost drum in a 6' high zone between four of the structural columns. This zone provides a visual connection outside to the old cemetery and orients funeral services in the Chapel of Light.

As light passes through differing levels of transparency created by one, two or three drums, a series of "waterlines" will be created. The waterlines define zones of increasing transparency as one looks up in the chapel. This visual transparency culminates in the dynamic roof basin, which reflects and scatters light into the chapel in a constantly changing fashion.

The chapel utilizes colored artificial light as a constant presence in the space. Banks of lights are located beneath a floor of onyx panels, which will admit diffuse orange light into the chapel drum. The variable nature of natural light passing through the roof basin will provide a sharp contrast to the steady light from the floor. On sunny days, the Chapel of Light will be bathed in a shifting pattern of sparkling light; at night and on cloudy days, the





chamber will be illuminated by the translucent onyx floor. This variable nature of the light is in contrast to the predictable cycle of light harvesting in the Chapel of Shadows, celebrates the act of reunion in the funeral ritual, and celebrates the Presence of Light.

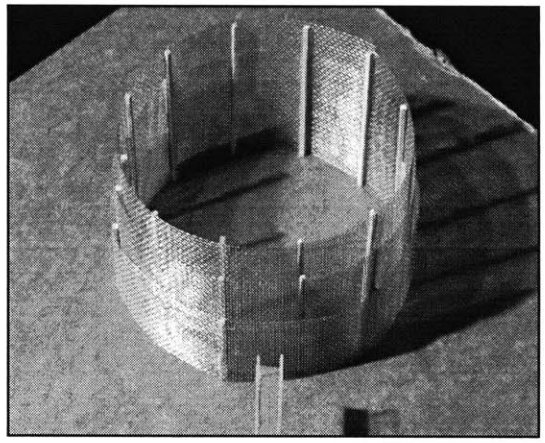


figure 87.1 (top, left). Roof basin sketches.
figure 87.2 (top, right). Computer model, enclosure drums.
figure 87.3 (bottom). Physical study model, enclosure drums.
Limitations on available computing power made it difficult to study the effects of the translucent / transparent perforated steel drums in the chapel. The physical model was necessary to study the drums' effect on incoming light.

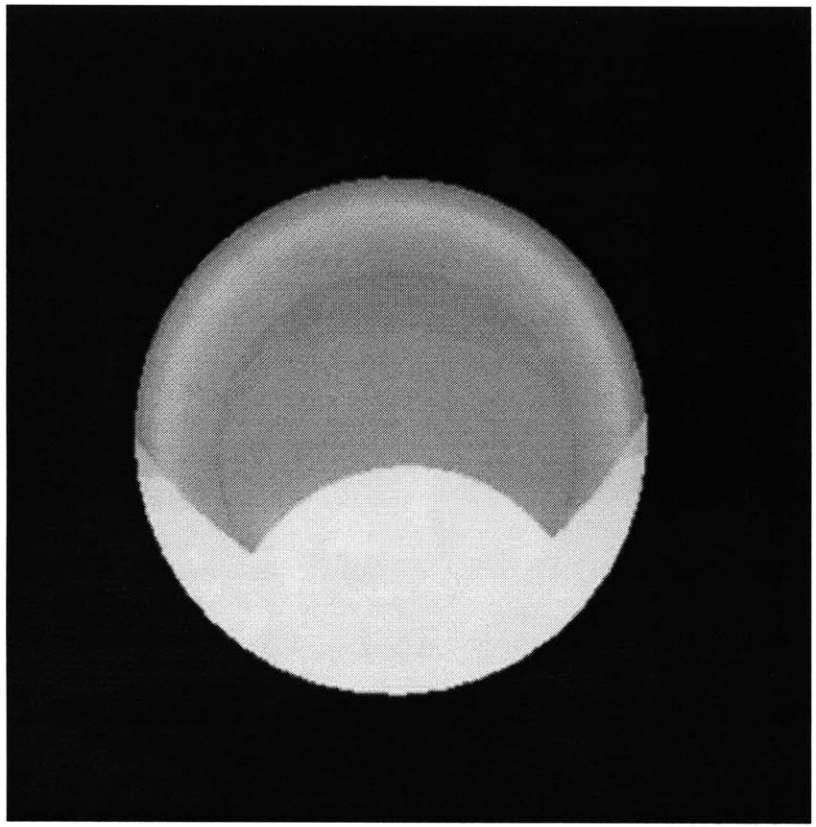


figure 88.1. September 21, 1200 hours.

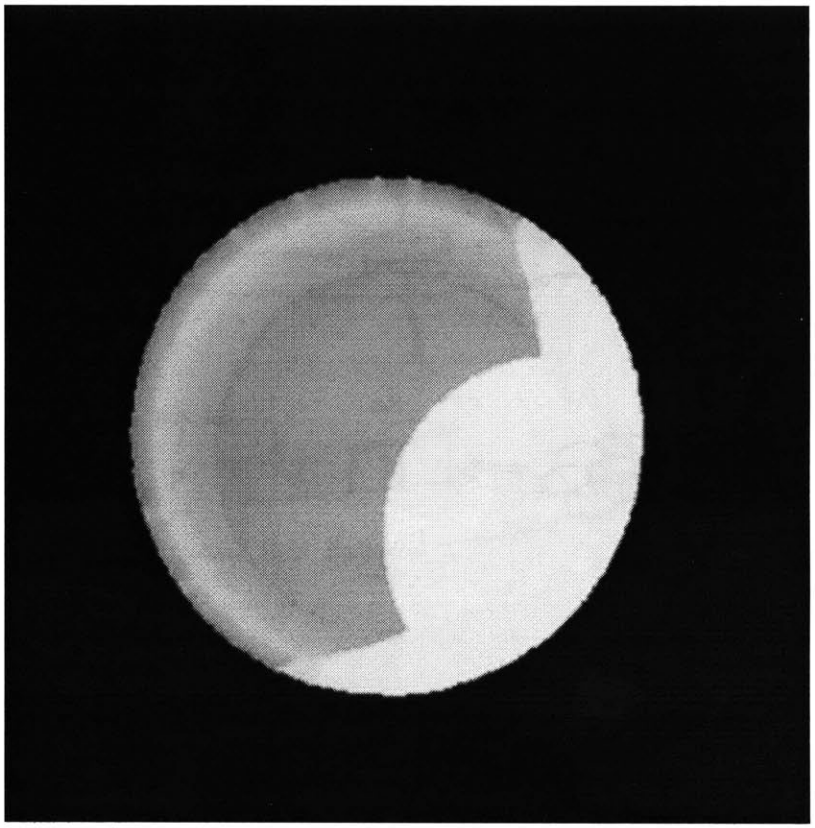


figure 88.2. June 21, 1000 hours.

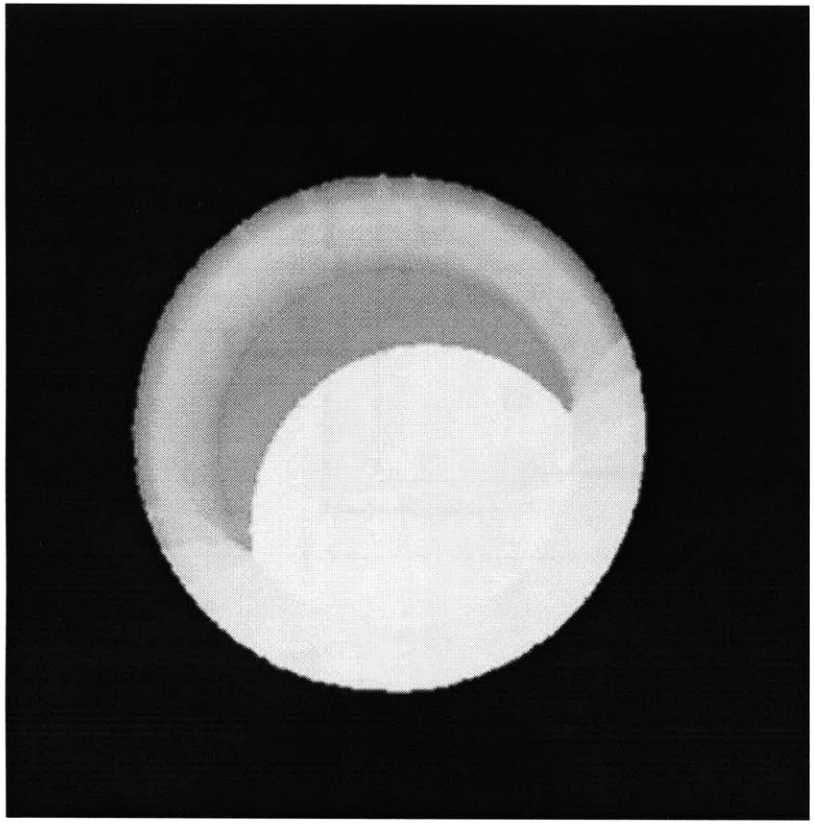
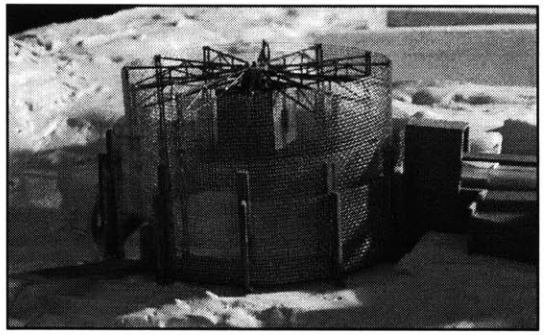


figure 89.1. June 21, 1200 hours.

Abstract modeling of buildings was a valuable tool in the light harvesting investigation. Abstract models permitted a quick confirmation of the performance of light within a space. This study is a part of a series of images to determine the penetration of light through the Chapel of Light's roof and into the interior of the drum.



light harvesting study

CHAPEL OF LIGHT
FINAL DESIGN

figure 89.2 (top). Chapel of Light, view east.
Morning illumination.

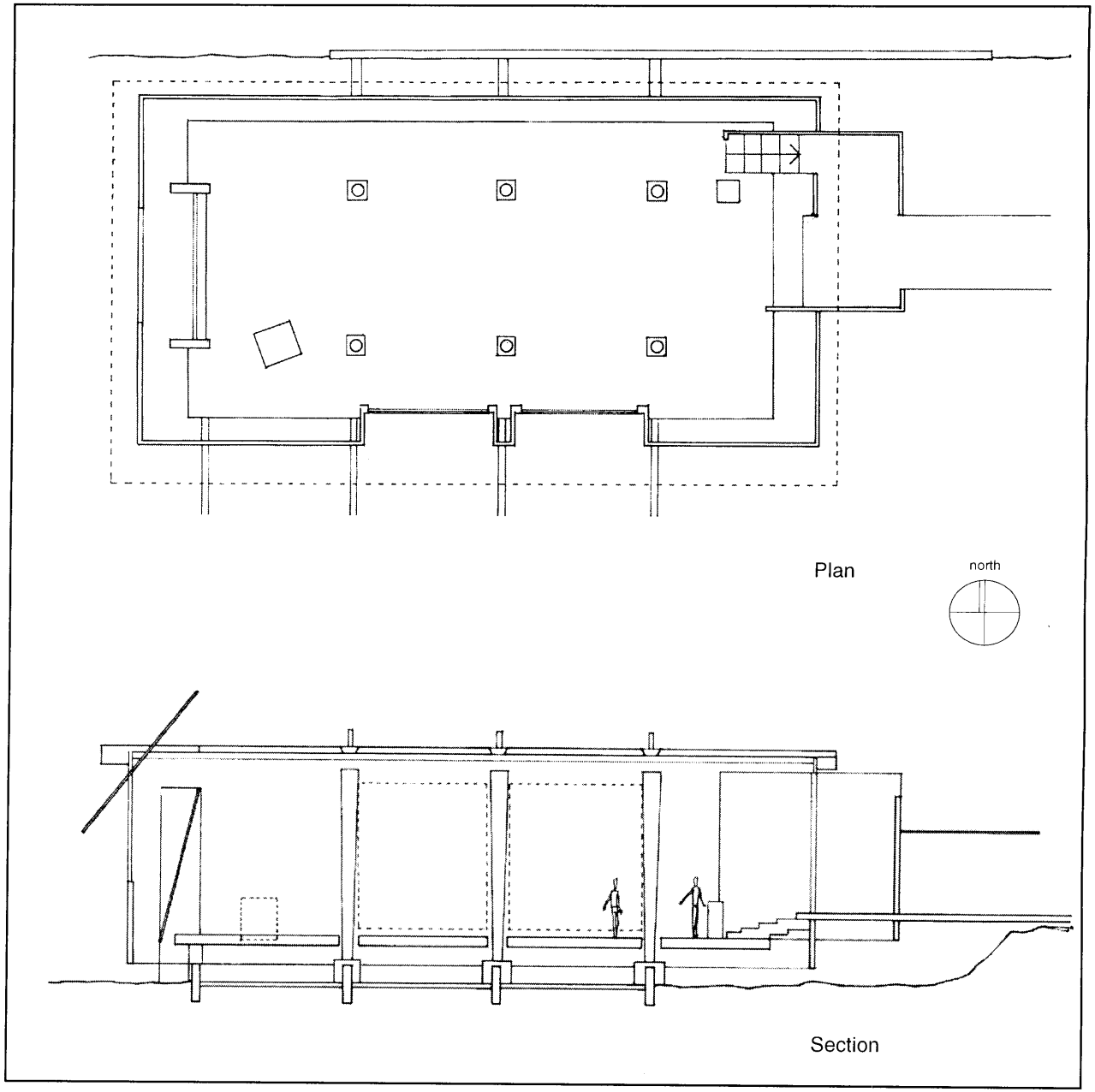


figure 90.1. Chapel of Shadows.
Final plan, longitudinal section.

figure 91.1 (facing page).
Chapel of Shadows, interior.

The Chapel of Shadows is designed to accommodate medium-sized funeral and wake ceremonies. Its orientation differs from the remainder of the complex—it is oriented with the spring and fall equinoxes. This plays a significant role in the chapel's light harvesting.

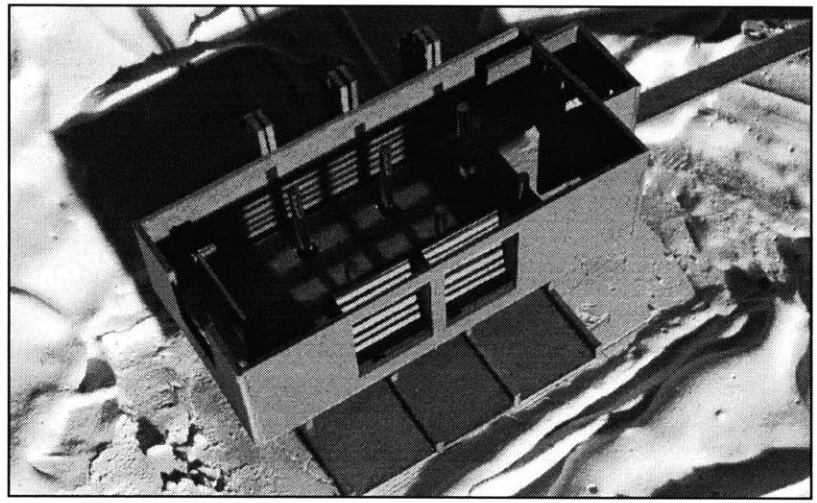
The chapel itself is a steel box with a sloped roof extending out beyond the edges of the box. The box and roof are externally supported by a cable system attached to three steel columns on the north side of the building. The box is suspended above the ground, allowing the ground to reflect light into the interior.

The concrete floor of the chapel is lifted four feet above the level of the ground. Holes in the floor slab permit six alabaster columns to rise from the raw ground below towards apertures in the roof. Entrance into the chapel is through a corridor extending from the Chapel of Light through a cubic threshold chamber. The floor of this chamber steps down to the northeastern corner of the floor slab where a glowing basin of water sits beside the stairs. From the entrance, an altar of frosted glass can be seen at the far end of the chapel. Seating for the mourners is in a zone defined by the columns, adjacent to the Shadow Windows in the southern wall of the steel box.

Light harvesting manifests itself as a sectional process in the chapel. Only a portion of the chapel is directly illuminated at any one time, allowing shadows to occupy the remainder of the

light harvesting

CHAPEL OF SHADOWS
FINAL DESIGN



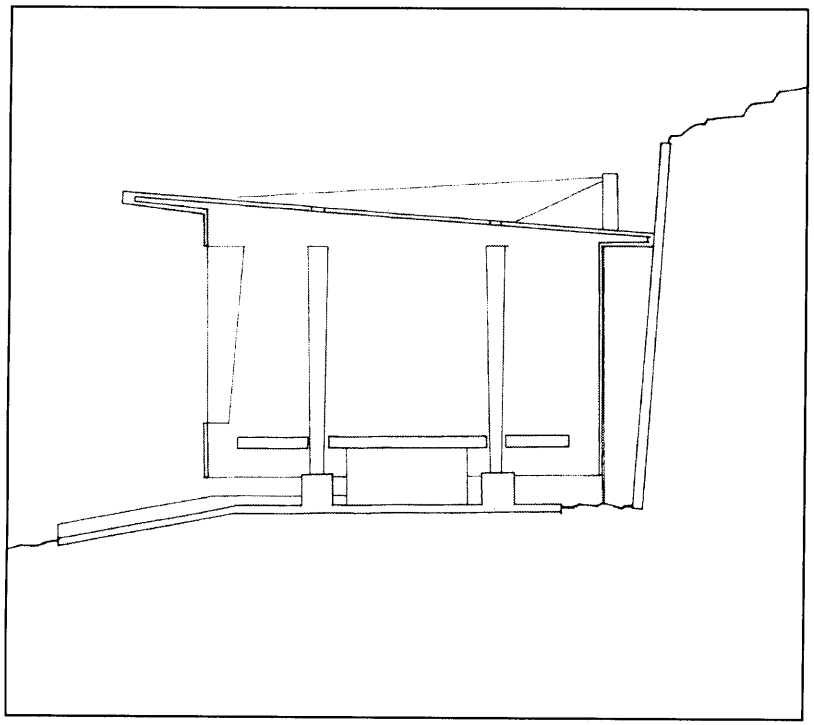


figure 92.1. Chapel of Shadows, transverse section.
Looking west, towards altar.

chapel. As the light changes, so does the nature of the Chapel of Shadows. Morning light occupies the east end of the building, entering through a hopper-like slit in the roof and threshold chamber. Noon light passes through a pair of Shadow Windows, openings with adjustable louvers. Afternoon light enters through the west wall of the chapel, and the incoming light is colored and diffused by colored glass panels. On the equinox, sunlight illuminates the interior of the chapel directly on its axis—intensifying the processing of light within the Chapel.

The artificial lighting scheme emphasizes sacred objects in the Chapel. The altar and water basin are lit in a manner that allows them to glow softly, emphasizing their presence in the shadowy space. The glowing altar will draw people into and through the chapel, and its placement encourages movement towards the seating area. The alabaster columns are illuminated from below the floor slab, and the holes direct the light upon the columns. Spotlights at the top of the columns illuminate the red metal underside of the roof—creating the illusion of light holding up the roof as the roof's edge disappear into the shadows of the chapel. Light becomes Structure.

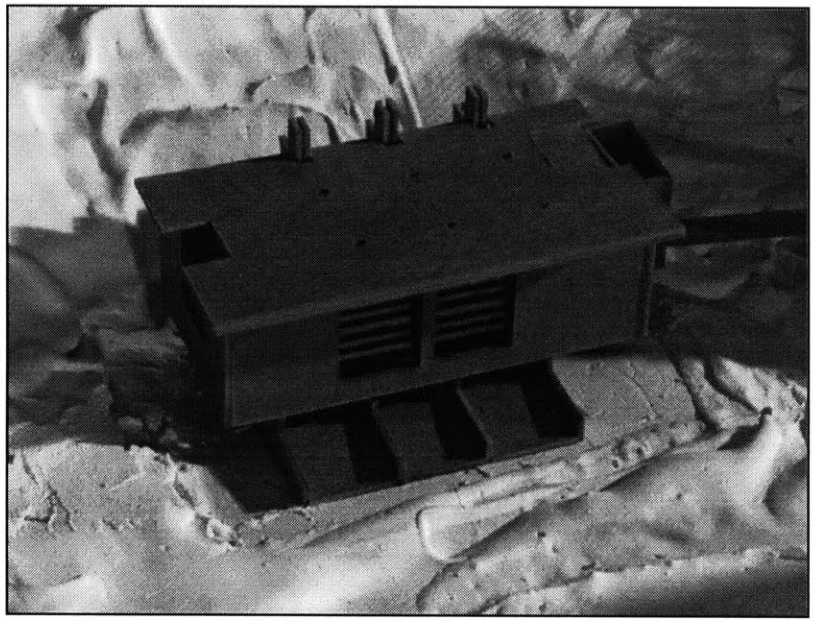
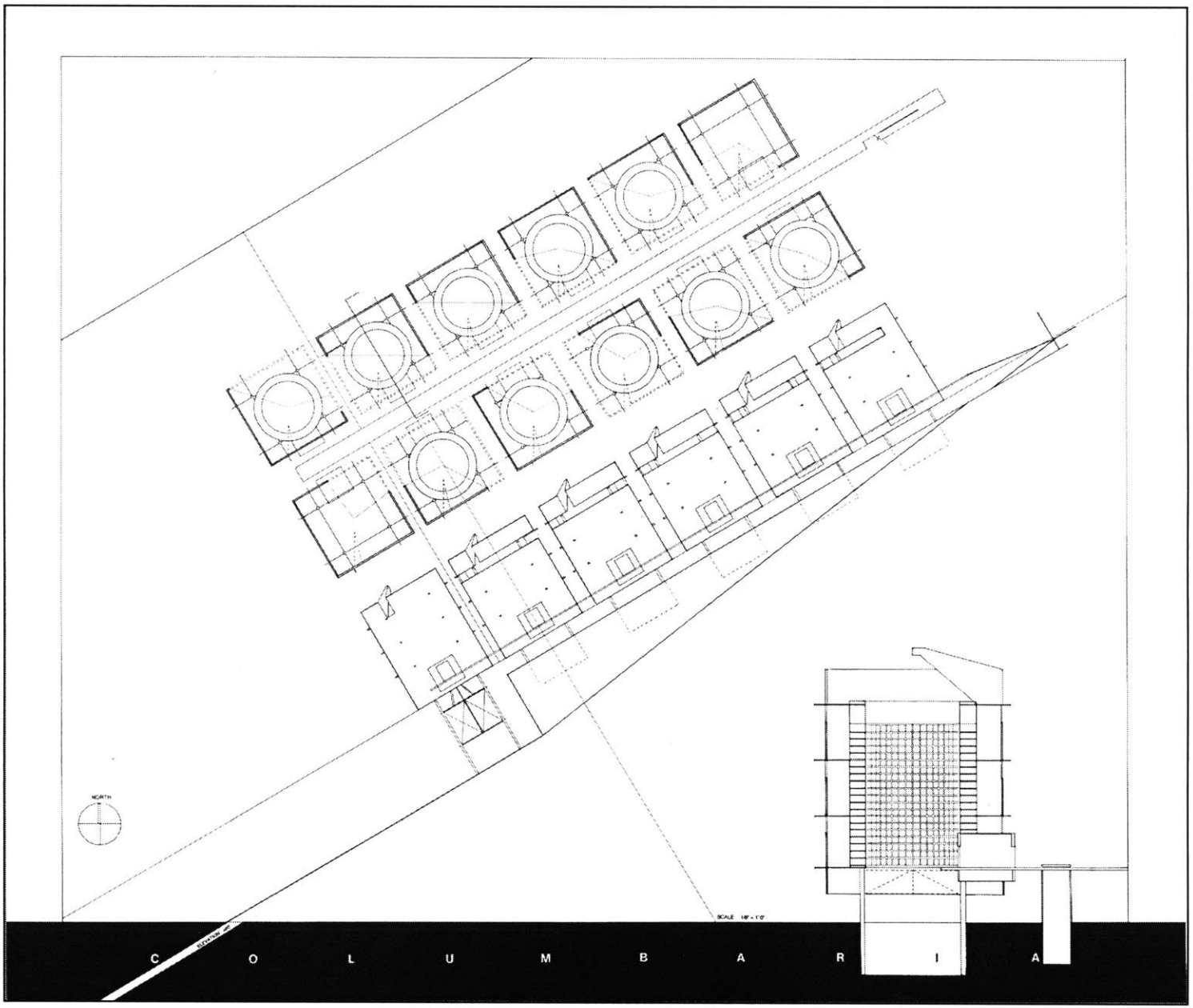


figure 93.1. Chapel of Shadows. Final model.


NORTH
C O L U M B A R I A

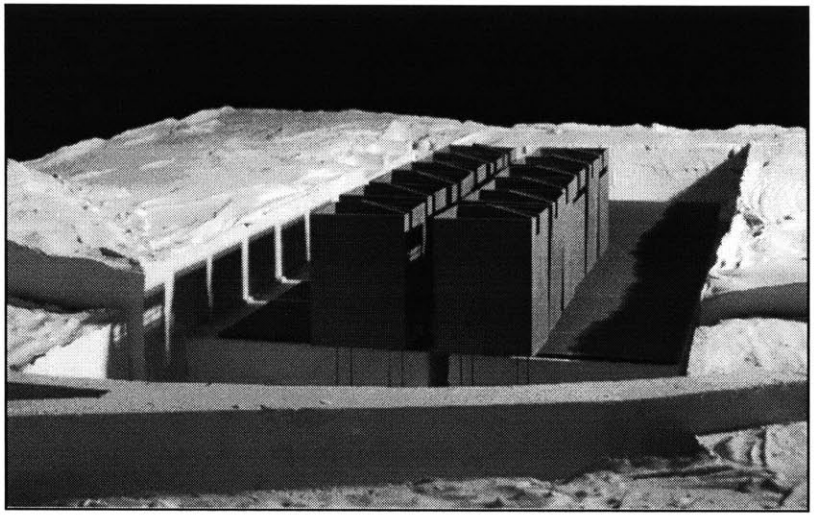
The columbaria, which contain the niches for the interment of cremains, are located within the quarry. Ten concrete columbaria cylinders are supported by steel frames over the quarry floor, and each is surrounded by an external sheathing of blackened copper plates on a steel frame. Two of the twelve frame-towers do not contain columbaria; instead, they are empty voids. The columbaria cylinders are 50' high, and each contains over 1,000 niches for interment—thus, the new extension can support 10,000 additional interments in the Blue Hill Cemetery.

The quarry floor beneath the columbaria has been manipulated in order to create a surreal, serene experience for visitors to the burial ground. The columbaria can only be reached by walking up a narrow, six-foot ramp which connects the lower and upper benches of the quarry floor; the experience is similar to walking through a crevasse. The upper bench has been recovered with topsoil and is seeded to produce a field of wild grass, which is kept at a height of three feet. The copper sheathings surrounding the columbaria drums are suspended eight feet above the grass field, and shallow depressions located beneath the center of each columbarium contain pools of still water.

A ramp provides access from the grassy field to a walkway, which leads a visitor to the columbaria. Each columbaria has a threshold chamber to mediate the experience of moving from an

columbaria
FINAL DESIGN

figure 94.1 (facing page). Columbaria, final drawing.



exterior space to the interior of the cylindrical towers of the dead. A small walkway cantilevers out into the void of each columbaria. The columbaria niches are sealed with translucent covers, and the drum is open to the sky. During the day, sunlight tracks the shadow of a sundial-like extension across the inner face of the drum; at night, hundreds of tiny lights illuminate the niches.

The experience of these columbaria is designed to invite contemplation of the nature of death. Once a deceased person's remains are interred in the sky, the physical connections between the living and the dead are broken. The memory of the living sustains the connection between living and dead. This is represented by the minimal nature of physical and visual contact between a living visitor and the interment niches; the presence of the grass field and the sounds of wind blowing through it will provide an opportunity for contemplation and meditation.

figure 96.1. Columbaria, view east over embankment wall.

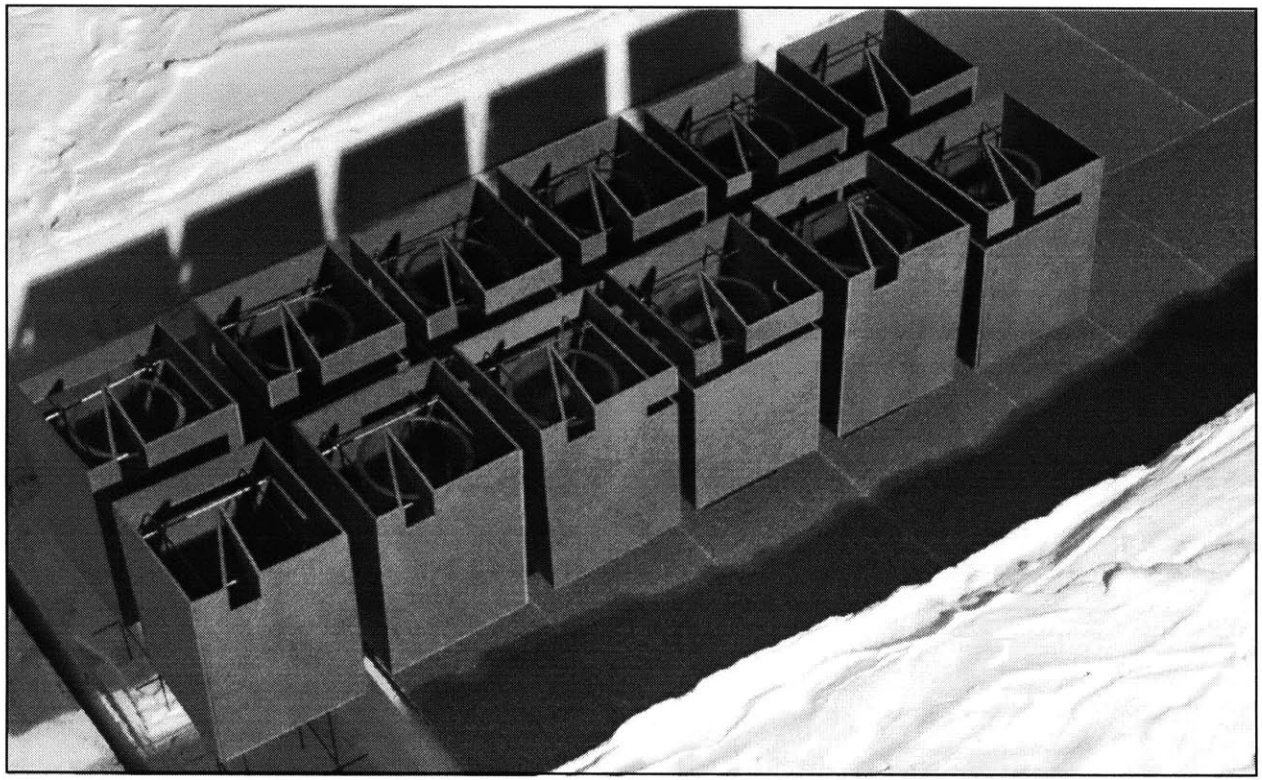


figure 97.1. ***Columbaria, from above.*** *Final model.*

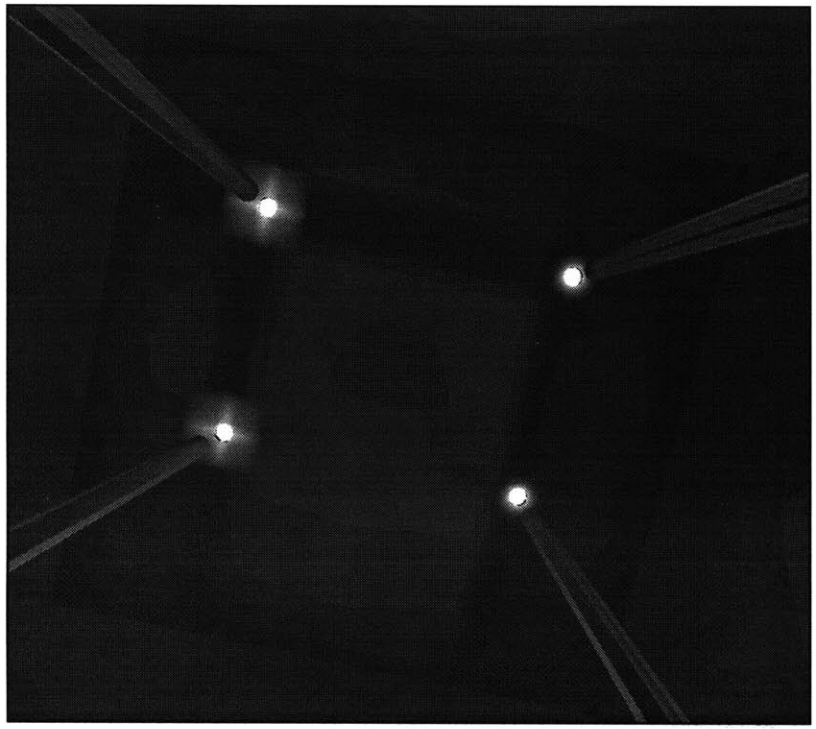


figure 98.1. Abstract model. *Apertures in ceiling directly relate to alabaster columns below, which illuminate the roof with concealed lights.*

figure 98.2. Abstract model. *Columns reach up to the roof, compressing the pools of light.*

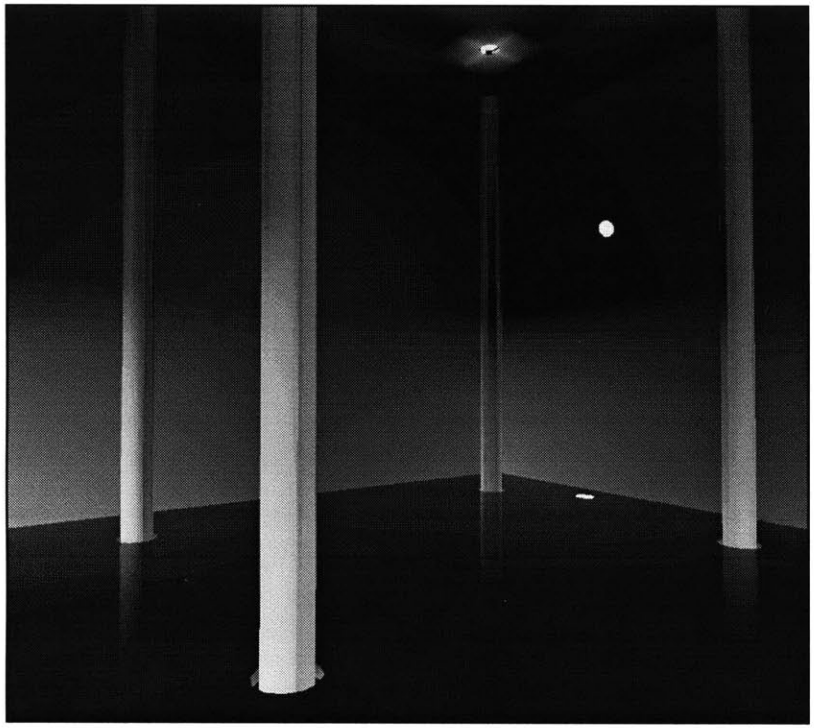


figure 99.1. Abstract model. *Columns illuminated from below the slab.*

light as structure

CHAPEL OF SHADOWS
FINAL DESIGN

This abstract model represents the final step in the development of the Active Harvesting columns the Chapel of Shadow. The alabaster columns are non-structural, as the roof is externally supported. A zone of shadow is created by recessing the roof to wall connection (fig. 92.1). Spotlights atop the columns create pools of light to support the roof. Light becomes Structure.

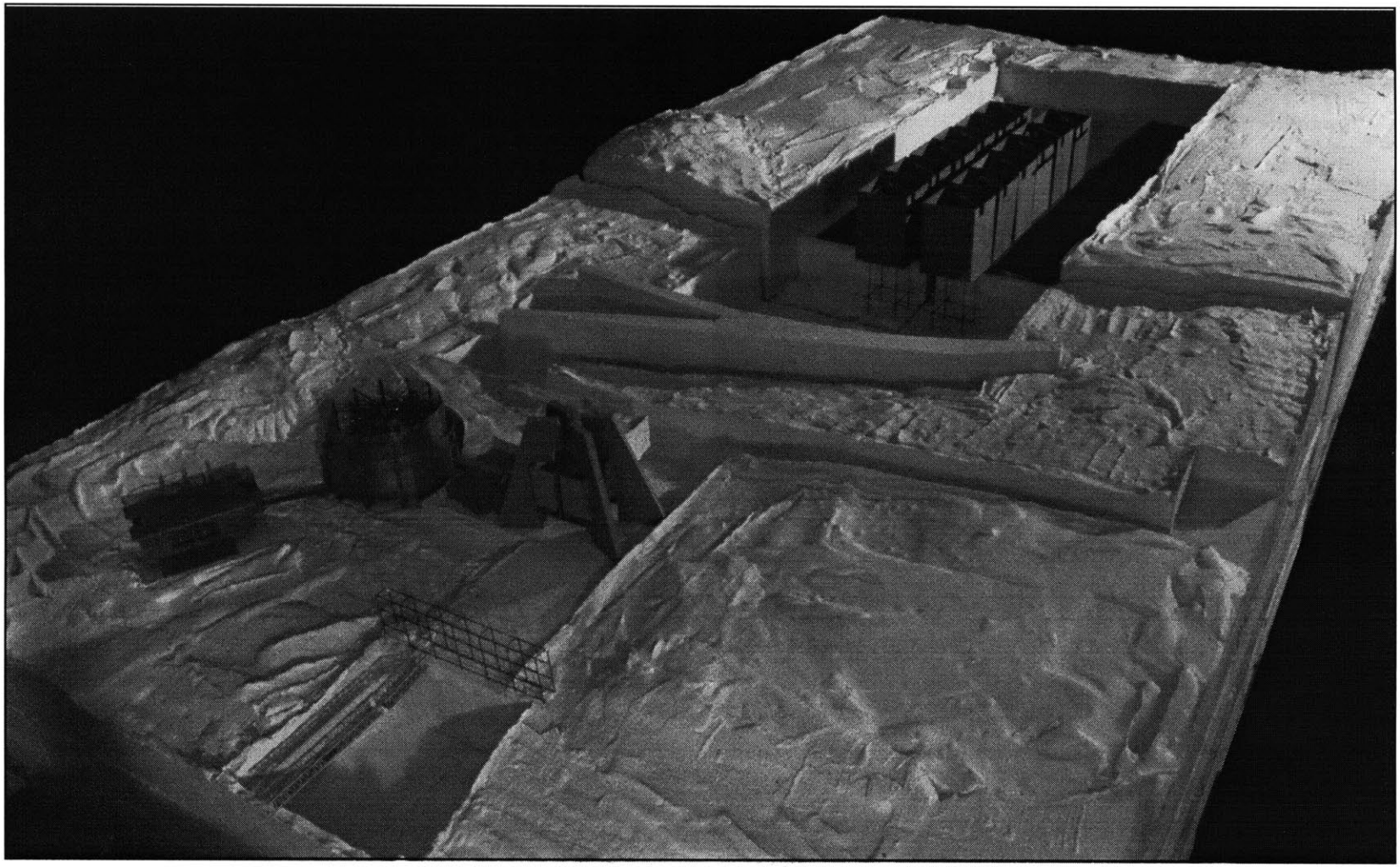


figure 100.1. Crematory complex and burial ground.

conclusion

The two semester investigation of the industrial cemetery has been invaluable. The process of design spawned an interest in a second investigation, illumination of the cemetery, which became the driving force for the project. The extra semester permitted a thorough investigation into many areas of the project with different media--traditional and computational.

As society continues to develop and spread the urban fabric, the probability of juxtaposition against sites of historic, nostalgic, or sacred importance will increase. Mediation will be required, and older typologies will have to redefine themselves to meet the needs of contemporary society. The industrial cemetery becomes one method of resolution in response to these future urban pressures.

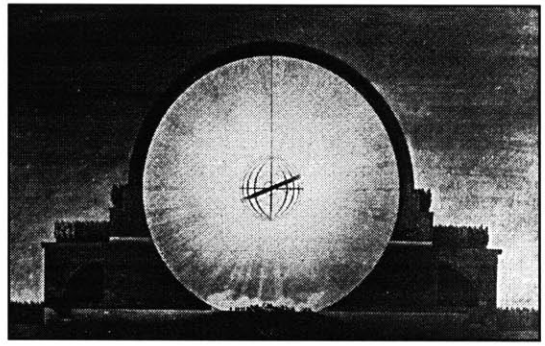


figure 101.1. Illumination of Proposed Cenotaph for Newton, Etienne Louis-Boulee.

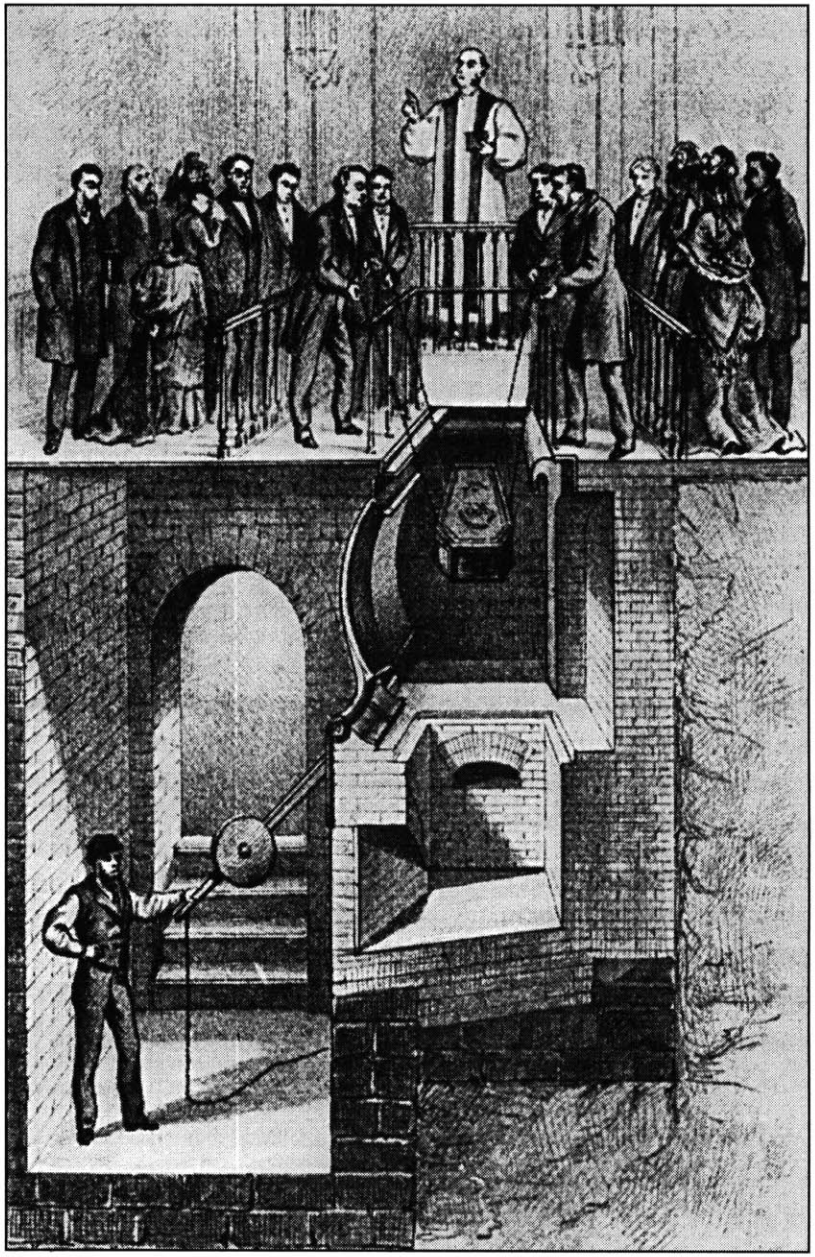


figure 102.1. Siemen's Cremation Apparatus. *At the end of the funeral, the casket is lowered through the floor directly into the retort below.*

APPENDIX A : CREMATION

Cremation was first introduced to the United States during the modern era in 1876, but its use as a method for disposal of human bodies dates to antiquity. It has been utilized by many different cultures, including the Greeks, Romans, Pacific Northwest Native Americans, and the Japanese. While ancient cultures often burned their dead for religious reasons, many cremations today occur for economic reasons or the decreasing availability of land for in-ground burial.

The cremation process is a very simple one: a body is placed into a flammable container, and both are then subjected to intense heat. The body is reduced to ashes and bone fragments, which are then pulverized to a fine, gray powder. This powder is also referred to as cremains, which may be interred in an urn in a burial ground, kept by the family, or scattered.

This act of burning is concisely summed up in Richard Selzer's description of a typical cremation:

> *The good fellow slides you into the over, and ignites the fire. If you are burned in your casket, an exhaust fan sucks away the wood ash, until there is only your body. He observes through a peephole at the back of the oven. Now he turns off the exhaust, and lets the flames attack the body. Three hours later, at two thousand degrees Fahrenheit, it is done. The oven is turned off.*[7]

Cremation can occur in one of two ways: directly, where the body is cremated without prior embalming or a viewing of any kind, or as a part of the funeral ritual. Regardless of the surrounding ceremony, modern American cremation law requires that "human remains shall not be cremated within forty-eight (48) hours after the time of death, as indicated on the regular medical certificate of death...unless such death was a result of an infectious, contagious or communicable disease, and such time requirement is waived."[8] This prevents cremation from being used as a method to conceal a murder, and it ensures that bodies are cremated with consent from the relatives of the deceased.

The ovens used in cremation are known as retorts. Modern retorts are constructed of heat-resistant brick with inner linings of refractory material. The bricks are enclosed by steel plates. The retort contains an outer door and an inner door, both of which are counterweighted to stay open when a body is being placed into the oven.

The efficiency of retort ovens has increased over time. Early crematories could only be loaded and unloaded from the front. For each cremation, the oven had to be heated up to incineration temperatures, the body placed inside and cremated, and the operators had to wait several hours for the inner chambers to cool in order to remove the cremains. Modern ovens may have a niche at the back of the retort where ashes can be relegated in order to allow the placement of another body into the oven. The cremains may be removed while the cremation of another body occurs, and energy is not wasted in reheating the oven for the next cremation.

Crematories are increasingly clean and efficient in processing bodies. Early crematories required large chimneys to dispose of

waste gasses and ash, but this is no longer necessary. The Bigelow Chapel crematory at Mt. Auburn Cemetery in Cambridge, Massachusetts, requires only simple metal flues for the disposal of heated air and waste gas, as a series of scrubbers and filters prevent particles from escaping into the air.

Massachusetts state law requires any crematory building to be associated with a cemetery, and located within the cemetery grounds. Most crematories contain chapels for funeral services because of this requirement, although many of these chapels have a hole for passing the body and its container to the "committal chamber," or crematorium anteroom. Although this may create a more efficient transportation of the body, it contributes to a disjointed funeral ceremony. Additionally, crematories usually contain a columbarium for interring funeral urns, and a memorial garden of some type for meditation or strewing of ashes.

figure 106.1. A rock crushing operation in South Korea.
This is a portable system, with a mobile crusher and sorter, and is smaller than systems in most quarry operations.

APPENDIX B : PROCESS

QUARRY EXCAVATION
AGGREGATE PRODUCTION
CONCRETE BATCHING

This appendix outlines the industrial processes utilized in a typical quarrying and concrete batching operations. While individual quarries and concrete plants may deviate from the process described here, these exceptions will be minor.

The nature of aggregate dictates the manner for removing rock from the walls of the quarry. In a quarry where it is important for large slabs of the rock to remain intact, such as a marble or granite quarry, separation of the stone from the quarry wall occurs in a very careful, planned manner. The planning in an aggregate quarry is less precise, as the rock is intentionally broken. Regardless of type, quarry planning is a complex process. The rock must be extracted from the land as efficiently as possible while maximumizing the quarry's yield. Most quarries have a mining plan which details the sequence for excavating material from the quarry walls and floors. These plans are updated as necessary; a typical mining plan is useable for 3-6 years.

Blasting aggregate is a careful, labor intensive process. A staggered series of explosive charges are used to separate the rock from the quarry wall. Charges are placed in rows according to the size and depth of the volume of rock to be removed. While the size of each blast can vary considerably, a reasonable estimate of rock displaced by a blast is a volume 60′ wide by 60′ deep by the height of the wall, usually 30′ to 40′.

The charges are placed in drilled holes that extend 3′ below

the elevation of the bench, or the working ledge at the bottom of the rock face. Each hole is filled with nitroglycerin, which is sandwiched vertically between two blasting caps. When a blast is performed, the explosion of blasting caps in each row is offset by a delay of several milliseconds. The rows closest to the rock face explode first; this practice allows as much of the rock as possible to fragment, and the explosion of an outer layer of rock provides room for the explosion and fragmentation of the rock layer directly behind it.

Noise is an important consideration in quarry blasting. For example, New Hampshire mining laws state mining blasts may not raise the ambient noise at a property line by more than 50dB. The noise level in a residential district near to a quarry blast may not exceed 110dB.[9] Many quarries are separated from residential neighborhoods by buffer zones of trees or natural landforms, as they provide visual and audible protection from the activity in the quarry. In order investigate some aspects of this thesis, noise requirements were not considered in defining the "ideal" quarry condition.

The "stepping down" in quarries to access lower layers of rock is called benching, and these levels are known as benches. An average quarry bench steps out 50' or more from the quarry wall. If a roadway for truck and machinery passage is required on the bench, its width may increase to 75' or more. Another common industry standard is a 2:1 bench width to wall height ratio. This allows room for maneuvering people and equipment, especially if a quarry wall collapses.

Once rock has been removed from the quarry face, the largest boulders are broken up and the rock is processed through a

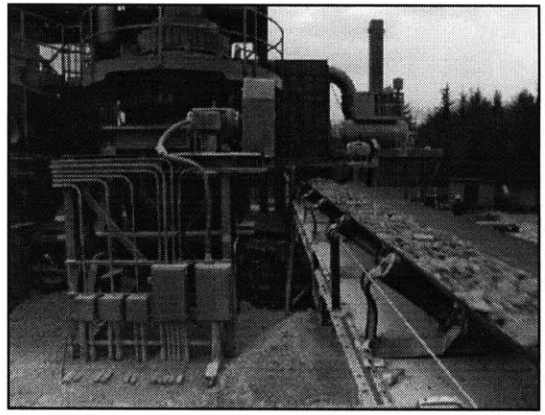
series of crushing and sorting operations. All quarries require an on-site crushing operation, and concrete batch plants may also have their own aggregate crushing facilities. The blasted rock is first dumped into a primary jaw crusher. A crusher of this type consists of a metal hopper with a manganese alloy "jaw" which breaks up the rocks against the steel walls of the hopper.

The rocks fall onto a conveyor belt and are transported to a secondary cone crusher. Here, rocks are fed through the top of the crusher to be ground into aggregate by the action of the crusher's "cone." The metal cone rotates around a grinding surface, pulverizing the rock in an action similar to an inverted mortar and pestle. The aggregate drops out of the cone crusher onto another conveyor belt, which transports it to a sorting machine.

One the way to the sorter, the aggregate is sprayed with water. This cleans the stones and reduces the amount of airborne rock dust from the entire crushing operation.

The sorting process consists of shaking the aggregate over a series of screens, each set at a 20 degree angle to the horizontal. A typical sorter has three plastic or metal screens stacked vertically over each other. Screens with the largest apertures are located at the top of the stack while the screens with a tighter grid are at the bottom. The screens act as a sieve: aggregate is dropped onto the top screen and travels across them by mechanically agitating the screens.

Aggregate falls through screens until it reaches a screen it cannot pass through, whereupon it is shaken off of the end of the screen into a hopper. The hopper drops the aggregate onto a conveyor belt, and the rock is deposited into a storage pile at the end of the belt. Aggregate that does not fall through the top screen



AGGREGATE CRUSHERS

figure 109.1. (top). Jaw crusher.
figure 109.2. (bottom). Cone crusher.

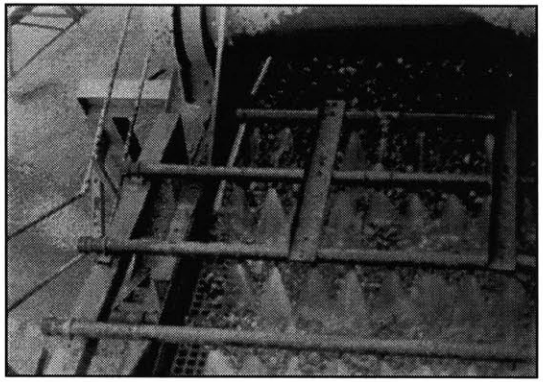


figure 110.1.

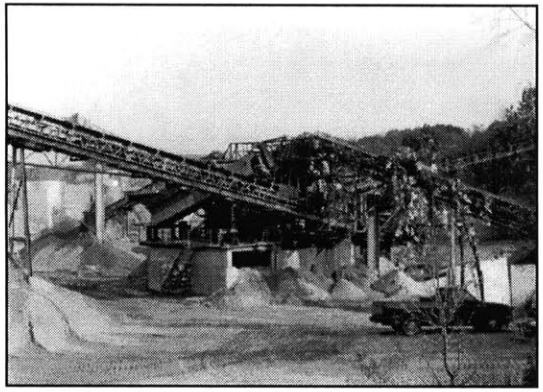


figure 110.2.

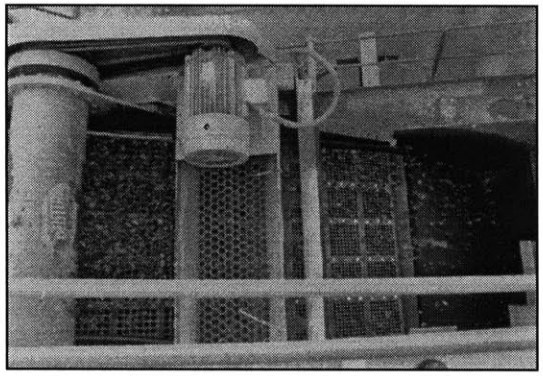


figure 110.3.

is transported back to the secondary cone crusher, recrushed, and resorted until the stone is small enough to be fall through the top screen.

Quarries generally create aggregates in several different sizes ranging from 1/4" peastone to 3" aggregate. Processed stone for use in concrete generally comes in one of four sizes: 1/4", 3/8", 1/2" and 3/4". Sand may also be obtained during the rock crushing and sorting process, and it must be thoroughly washed before it is deposited onto a storage pile. More often, sand is obtained from a sand pit away from the quarry site.

Aggregate used in the creation of concrete is generally stored in one of two ways—outdoors in a large pile, or in a steel hopper. The option chosen depends on the climate and amount of space available. Batching plants in cold winter climates must be warm up aggregate stored outdoors by spraying it with warm water before introducing it into the concrete mixer or mixing truck. Outdoor aggregate piles often have hinged-jaw hoppers buried beneath their centers. Stone is released from the pile through the hopper and onto a conveyor belt as it is needed.

To create a batch of concrete, four materials are required—aggregate, water, Portland cement, and sand. While sand can be stored in a manner similar to aggregate, cement and water are contained in large silos or holding drums. Pipes are used to transport water and cement from holding areas to the concrete plant's mixing chamber.

Two different processes may be utilized to mix concrete: wet-batch and dry-batch. In a wet batch plant, the four components of concrete are mixed together in a rotating chamber to create a slurry. Once sufficiently churned, the slurry can be released into a

cement truck for transportation to the construction site. In a dry-batch plant, all of the materials are separately released into the truck, the truck mixes the concrete inside its rotating chamber. Additives such as plasticizers are stored in plastic drums or tanks, and they are injected into the mixture after all four materials have been combined. Wet-batch plants tend to create a more even and consistent mixture of concrete, and the amount of ambient cement and rock dust in the air is less than a dry-batch plant.

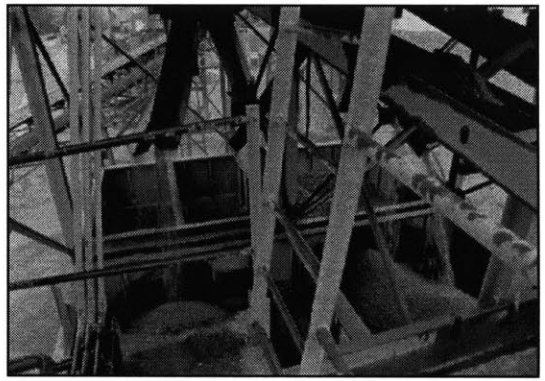
A load of concrete is usable for 90 minutes after it is mixed. If this time limit is exceeded, the load is usually rejected and returned to the concrete plant. Waste and rejected loads are cast into large blocks, which are often used for noise abatement in the concrete facility.

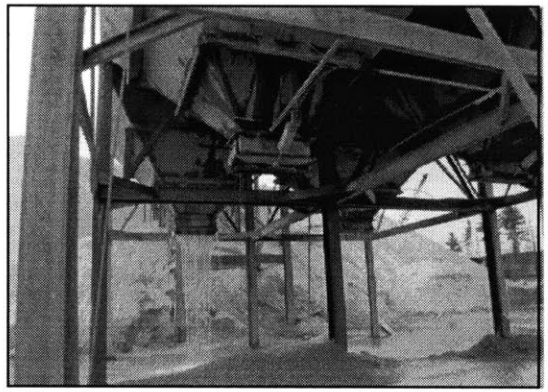
SORTING AGGREGATE

figure 110.1 (top, facing page). *Aggregate is cleansed with water before entering the sorter.*

figure 110.2. (middle, facing page). A typical sorter. *The conveyor belts move sorted aggregate to separate storage piles.*

figure 110.3. (bottom, facing page). *Aggregate passing across sorting screens. The hopper to the right collects unsorted stones for recrushing.*





CONCRETE BATCHING

figure 111.1. (top). *Aggregate is stored in hoppers, separated by stone size, above a mixing chamber.*

figure 111.2. (bottom). Dry-batch tower. *Aggregate is discharged from the hopper into a truck below; water, cement and sand are pumped into the truck. The truck mixes the batch en route to its destination.*

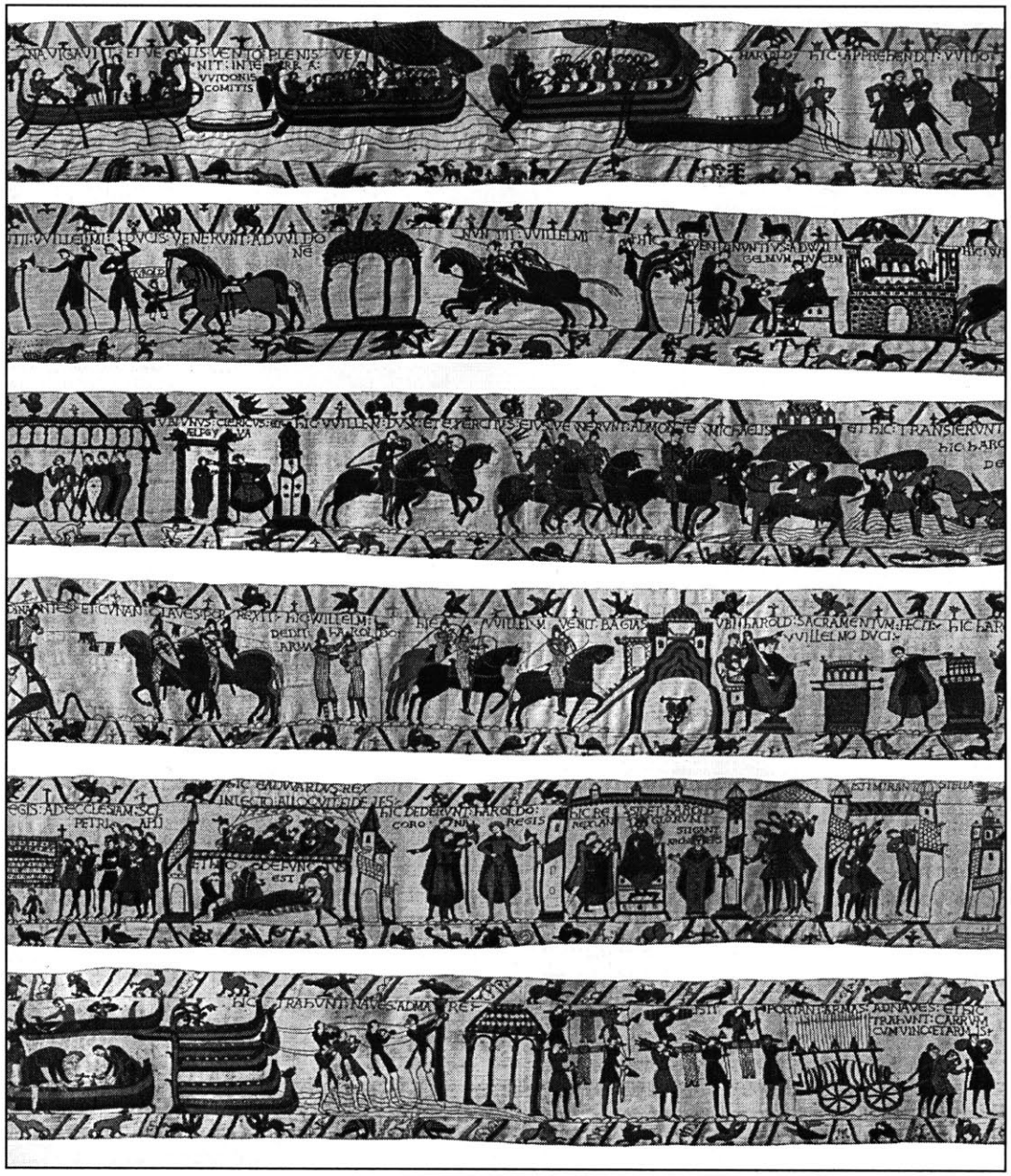


figure 112.1. Scenes from the Bayeux Tapestry.

APPENDIX C

THE BAYEUX TAPESTRY PRESENTATION TAPESTRY

The Bayeux Tapestry is an embroidered hanging commissioned to commemorate the invasion of England by William of Normandy. It presents the pictorial history of the events that prefaced the invasion of England, the invasion itself, and the defeat and death of King Harold at the hands of William's army at the Battle of Hastings in 1066. The tapestry is 230 feet long and 19 inches high, and it was originally hung in the Bayeux Cathedral in France during religious festivals.

The nature of the material generated over the course of this thesis lent itself to a long, linear presentation; in effect, the investigation of the industrial cemetery and the harvesting of light could be presented as a story. The organizational strategy of the Bayeux Tapestry is an excellent analog for the presentation of the final thesis project, which was to occupy a linear space 36 feet long and seven feet high (fig. 51.1)

In the Bayeux Tapestry, the main story occupies the center of the tapestry. The upper and lower borders feature geometric and animal designs, but often they are appropriated by the main body of the tapestry to accomodate larger images, or to provide additional information about the story. The scene where Harold is crowned King of England under the bad auspices of Halley's Comet is an excellent example of this usage of the border space.

In the main body of the tapestry, commoners wonder at the Comet, which occupies the upper border. When Harold is told of

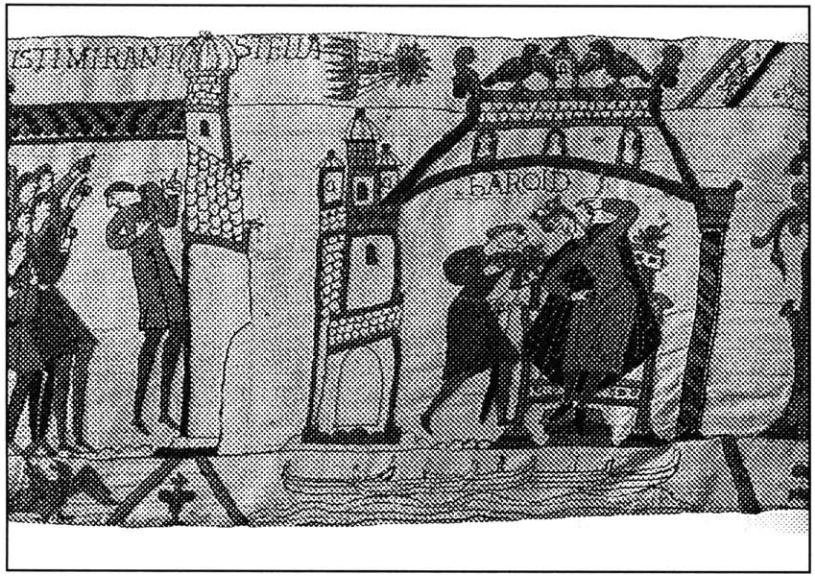


figure 114.1. Bayeux tapestry, detail.
The upper and lower borders of the Tapestry are appropriated for the scene of the ill omen surrounding Harold's coronation. This becomes an analog for the Presentation Tapestry, where final drawings related to the Light Harvesting process appear above and below related explorations in the band.

the Comet's appearance in the next scene, the topic of their discussion becomes clear: the ghostly invasion ships occupying the lower border of the tapestry. [10] While the thesis presentation does not rigidly conform to this method of storytelling, it utilizes the hierarchical scheme and tripartite organization of the tapestry.

In the industrial cemetery "tapestry," the Harvesting of Light becomes the main device for organizing the drawings and images. The harvesting is relegated to an 18 inch high by 32 feet long band that tell the story of this investigation through sketches and computer images.

The Ritual / Sequence diagram occupies the far left end of the presentation, as it fronts the primary questions of processes and sequences in the thesis. Next to it is the harvesting tapestry, which begins with the conditions of the site, and early investigations on the quarry and columbaria. Early formal attempts to define the Harvesting process in both Chapels follow, and they lead into the Harvesting Diagram.

The Harvesting Diagram is a pivotal point in the presentation, for it divides initial information about the thesis (site plans, extension proposal and the thesis project site plan) from the investigations into the buildings of the project (the Chapels, crematory tower, and columbaria).

The harvesting band on the right side of the Harvesting Diagram deals with the redesign of the Chapels of Light and Shadow, and the crematory. The band culminates with the final investigation of the Chapel of Shadow where Light becomes Structure.

The computer images generated during the light harvesting investigation are purposefully kept small, and contained with

the harvesting band. The intention behind this decision was to prevent them from visually dominating the presentation. Their location at the same level throughout the tapestry allows them to create a visual band of information within the greater body of the tapestry.

The thesis drawings are organized carefully above and below the harvesting band. Conceptually, contemporary and future information is presented above the band, while historical information is relegated to the area beneath the band.

The intention behind this complex presentation is to give a sense of hierarchical order to the investigations of the industrial cemetery. The investigation of light is one that can transcend both program and site, and therefore occupies the most important section of the presentation. The analog of the tapestry allows the thesis investigation to be presented as a process of discovery, a year-long tale in two parts.

NOTES

1 Iverson, Death to Dust, Galen Press, p.530.

2 Ibid., p.249.

3 Personal conversation with John Hynes, Mt. Auburn crematory director, October 1994.

4 Iverson, p.258.

5 Ibid., p.246

6 Ibid., p.519.

7 Ibid., p.236.

8 Ibid., p.247.

9 Personal conversation with Ted Kaler, PIKE Industries, November 1994.

10 Grape, The Bayeux Tapestry, Prestel-Verlag, p.124.

All illustrations and photographs are by Richard Stump (author) unless otherwise noted.

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figure 16.1 Map, Norwood MA, United States, Geologic Survey, 1985.

figure 17.1 Map, Braintree Historical Society Archives, 1892.

figure 38.1 Collins, Antoine Predock, Architect, Rizzoli Press, p.53.

figure 39.1 Plummer, Light in Japanese Architecture, A + U Press, p.196.

figure 101.1 Curl, A Celebration of Death, Batsford Press, p.190.

figure 102.1 Curl, p.304.

figure 106.1 Courtesy of Telsmith, Incorporated.

figure 112.1 Grape, The Bayeux Tapestry, Prestel-Verlag, p.2.

figure 114.1 Grape, p.124.

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Richard E. Stump
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